SCIENTIFIC AMERICAN SUPPLEMENT No. 98

Scientific American Supplement, Vol. IV, No. 98.
Scientific American, established 1845.

NEW YORK, NOVEMBER 17, 1877.

Scientific American Supplement, $5 a year.
Scientific American and Supplement, $7 a year.

RETORT SETTINGS.

The accompanying engraving represents two different methods of setting five retorts in a bench, one method being illustrated in the upper, and the other in the lower figures. In both, the absence of transverse walls will be remarked—a system of setting to be recommended whenever good retorts, that will not break by the action of heat, can be obtained.

Fig. 1 is a front view, with half the front wall removed for the purpose of showing the interior. Fig. 2 is a longitudinal section, and Fig. 3 the plan with the arch removed.

The two lower retorts are placed upon the flues, *o*, which extend from within a few inches of the front wall to the vertical flues communicating with the main flue, indicated in plan on Fig. 3, and by the dotted lines on Fig. 2.

The upper side retorts are supported by fire-clay saddles, or quarries, placed at intermediate distances, the spaces between them being filled throughout with soap bricks, or brick on edge, according to the width of the space. By these means the current of caloric is prevented from passing at these points. There is also another line of bricks placed between the retort and the arch, marked *h*, extending from the front wall to within a foot of the back wall, thus leaving an orifice of that length at each side for the passage of the current. These are not shown in Fig. 3, in consequence of the section being below that point.

The heat, as generated in the furnace, F, is conducted directly to the whole of the retorts, the lower ones being protected at the point, C, from its most vivid action. The current of heat passes in the direction of the arrows, through the orifices at the end of the partition, *h*, returns into the space, *b*, enters the flue, *o*, and thence passes to the vertical flues.

This setting is very economical, as regards the consumption of fuel; but for its satisfactory adoption, good retorts are, as we have already said, indispensable. The retorts are 21 by 14 inches by 8 feet or 8½ feet long internally, which dimensions and forms we believe, are most suitable for works of every denomination, as from their area they are capable of receiving large charges, and are easily drawn—two important considerations as effecting economy of labor in carbonization.

The second method differs slightly from the first, and is one which has been adopted by a gentleman in the North, whose carbonizing accounts show a greater return upon the coal consumed than those of any other engineer of our acquaintance.

In Fig. 4 it will be observed that a large portion of the lower retort is exposed to the most vivid action of the heat, and although this, in our opinion, cannot be recommended, we are assured that the retorts are not injured by this close contact with the fuel. This is a theory which is supported by a well known engineer of ability, who states that, under like conditions, the coal within the retort tends to preserve it, by the quantity of caloric being continually carried off by the gas.

The principal difference between this setting and that first described consists in dispensing with the piers for supporting the top retorts, which repose on slabs shown in section Fig. 5, and in plan Fig. 6. These slabs are laid on the upper retorts, having a space of about 18 inches long at the end. There are also partitions between the lower retorts as well as at the sides, so arranged that the current must pass to the end of the slabs before it can return to the flue, *o*. The action, being, with one exception, identical with that described, need not be repeated. That exception is that, whereas, according to the first system, the current passes from the flue, *o*, to the vertical flues, in this it passes at once to the main flue, without the intervention of a damper.—*Journal of Gas Lighting.*

THE LOWE GAS PROCESS.

A QUESTION IN GAS CHEMISTRY.

To the Editor of the Scientific American:

As the national journal of progress in the civilized arts, you will, I am sure, be glad to record the steady advance of the Lowe gas process, which appears to be fully justifying its promise of furnishing at a reduced price a better light to the public than the old coal system has succeeded in doing. The works erected at Manayunk Station, Phila., and which went into operation August 4th, 1876, have distributed gas without a day's interruption, all rumors to the contrary notwithstanding.

Except for the temporary annoyance incident to the solution of the old deposits of coal-gas in mains, the new gas has given general satisfaction. This period, though brief, is inevitable, where the carburetted water-gas is put out through the pipes befouled by the old system.

New works have for some months made gas for Harrisburg, and more recently the process has started in Lancaster, Penn., where fine works have been erected. In both these places the citizens are rejoicing over the greatly improved quality of the light and the large reduction in their bills, and are patronizing the new company most liberally.

At Indianapolis, a Lowe plant is going in rapidly, and will probably fire up during November, but by far the most extensive works yet built upon this system will, during the present month, make gas in the city of Baltimore. They have a capacity of a million feet per day, with fifty miles of first class mains all laid and arranged for future extension. As an illustration of the popularity of any honest effort to meet the just demands of the public on the important matter of gas lighting, it may be stated that something over one half of the entire consumption of the city is said to be pledged to the new enterprise. But aside from these evidences of material advance, the Lowe process is opening some new questions in the department of gas chemistry, which are collateral proofs that it is unlike all preceding water-gas methods in the important item of practical success, but in the chemical phenomena as well.

For example, eudiometric analyses show 1,000 cubic feet of the gas resulting from the expenditure of 50 lbs. of anthracite coal (including the amount burned under the boiler) used in decomposing the steam, and 3 gallons crude petroleum, of gravity 46 degrees, to have the following composition, viz.:

Hydrogen	64.66
Marsh Gas	24.73
Carbonic Oxide	2.72
Olefiant	4.81
Sulphuretted Hydrogen	80
Carbonic Acid	19
Ammonia	37
Nitrogen (estimated)	1.31
Oxygen	41
	100.00 volumes.

As to the correctness of this table I can only state that it comes over the signatures of Dr. R. E. Rogers, of Pennsylvania University, and Prof. Lemuel Stevens, of Girard College, who gives it as the result of repeated tests. It should be stated further that, so far as the point at issue is concerned, it is confirmed by the reports of other disinterested experts.

The surprises which it contains are the very small percentage of carbonic oxide and the unexpectedly large one of marsh gas. The one in part accounts for the other, but

Fig. 1.

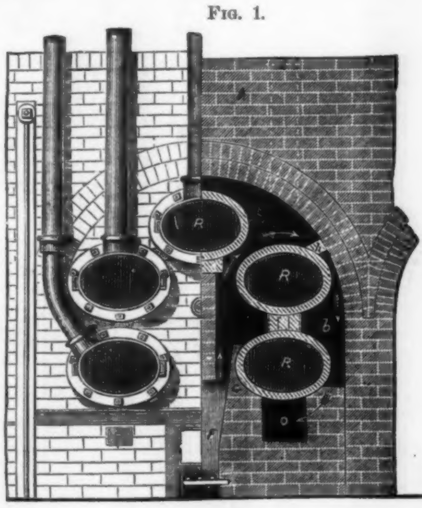


Fig. 2.

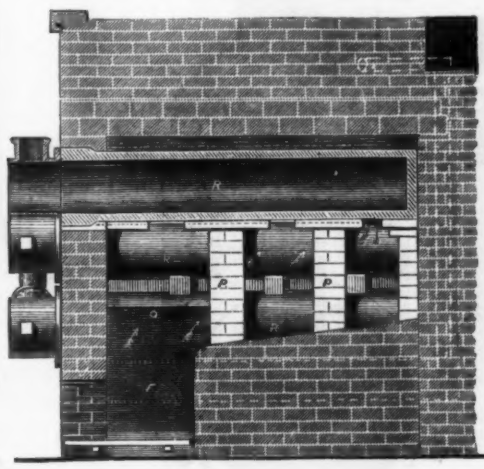
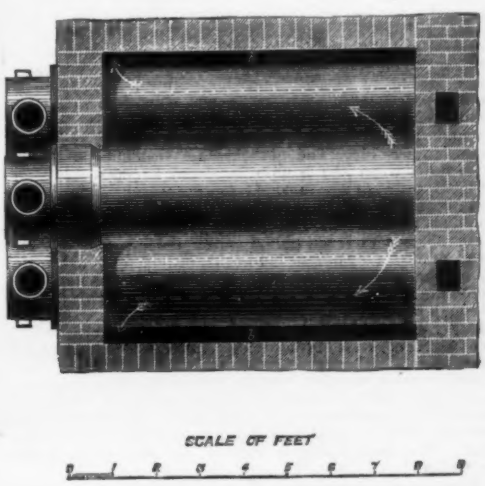


Fig. 3.



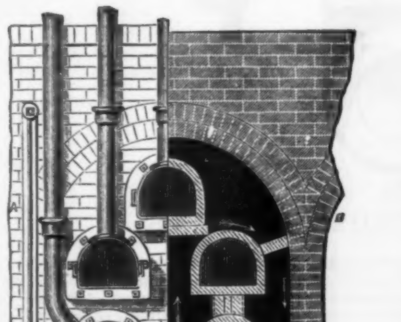


Fig. 4.

Fig. 5.

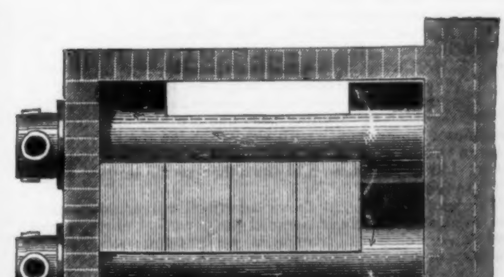


Fig. 6.

METHODS OF SETTING FIVE RETORTS IN A BENCH.

only in part, for the real question of interest is, "What has become of the oxygen of the water?"

All gases heretofore produced by the action of nascent carbon upon steam have shown a composition, approximately, of about 66 volumes of hydrogen and 34 of carbonic oxide. In fact, the decomposition of the water was accomplished by the strong affinity of the carbon for the oxygen, which, being seized upon by the former, combined and made carbonic oxide, leaving the hydrogen free. In this case, however, the carbon has forsaken its old love and united with the hydrogen to form marsh gas. That it can be driven to this by high temperatures has been established by laboratory experiments; and the heats employed in the Lowe process being exceptional, we accept this as an explanation of one item of surprise. But where has the oxygen gone? Probably the principle of the disassociation of gases at extreme temperatures comes in here, and, finding the oxygen deprived of its natural affinity, carbon, as explained, holds it suspended in its free form until, emerging from the superheater, its temperature reduced and cheated of the carbon, it reunites with a due proportion of hydrogen, and reforms water. "But," says a critic, "all the O and H present in the process are the sole result of the decomposition of water, and to my dull comprehension it would require all the H to reconvert the O to water." This objection, which the *Gaslight Journal* puts forth with a warmth that betrays dissatisfaction with the *fact* rather than the explanation of it, is not honest, because, having employed beside the water not less than 34lbs. of coal (in the generator) and 3 gallons of petroleum (for 1,000 cubic feet of gas) it is but fair to bring their lements into the calculation.

Some hydrogen may be derived from the coal, and a considerable volume undoubtedly is from the oil, which contains, approximately, 180 cubic feet for each gallon.

It should be remembered that an essentially new feature in the Lowe process, viz., the introduction of the various gas-making materials into the same chamber simultaneously, and into direct contact with the fire, may produce some entirely new results, chemically considered.

It is quite possible, of course, that the writer's theory may be only partially correct, or it may be all wrong; and he certainly does not intend to insist upon it if a better one is brought forward.

If the analyses are true, for which the gentlemen named must be held responsible and not the writer, the alternative presented would seem to be:

1st. The oxygen must have been consumed to carbonic acid. In this case, it would appear in the purifiers; but it does not so appear, the crude gas carrying only 3.50 of this constituent, and one bushel of lime purifying 5,000 to 5,700 cubic feet of gas.

2nd. A re-association of gases into some new connection, unknown in chemical investigation, resulting from the direct action of high temperatures.

3rd. The re-conversion into water of the oxygen, as explained.

The last seems the most probable, but suggestions upon the subject would prove interesting.

Respectfully,
GEORGE S. DWIGHT.

NEW YORK, October 10, 1877.

VALVES FOR GAS AND OTHER PURPOSES.

MESSRS. C. & W. WALKER are justly celebrated for the manufacture of gas valves, to which they have devoted much attention during many years. We might give a brief description, with illustrations, of some of the most useful forms of these.

Fig. 21 is an above-ground screw wedge-valve, intended principally for use on the gas-works. This valve is well adapted for purifiers when single valves are preferred, as it is opened and shut down on wedges by a screw, which it is necessary to employ when wedge-valves are used to produce a free movement to and from the seatings. The screw is protected by a cover, so as to prevent corrosion, and an indicator is geared to it to show when the port is open or shut. An underground screw-valve for shallow street mains is shown in Fig. 22. The gate in this instance progresses downwards when the handle is turned to open it. It is actuated by a square-threaded screw, which is protected from corrosion by being enclosed in a pipe connected by trunnions with the slide, and closed by a stuffing-box.

Fig 23 is a rack-and-pinion valve; the screw is left exposed as shown for use on the works, or boxed up and working on the side for street-mains; the teeth of the rack-and-pinion are made strong enough to prevent their being broken by rough usage.

In Fig. 24 is exhibited a double-faced valve for mains of large diameter, with surfaced joints at A and B, for taking out the screw and gate respectively. The latter is a rigid wedge of solid cast-iron, having two perfectly scraped surface facings, fitting between those on the body, which are also surfaced; a spring in two short halves, and therefore not liable to break, is used only for scraping the front facing clean. The front facing is vertical; the back facing forms the wedge.

When a valve is made use of as an auxiliary to the governor for affording the supply of gas to a town, the regulating indicating column and valve, exhibited in Fig. 25, will be found well adapted for that purpose. Its position is on the by pass main of the governor. The disk on the face of the column represents the extent to which the valve beneath is opened, both being actuated simultaneously by the screw. If this be observed, no mistake can arise in the working of it. The area of the opening in square inches, and the size of pipe to which the opening is equal, are also indicated by the pointer which moves with the disk. To the sides of the column two pressure-gauges are fitted, one connected to the works side of the main, and the other to the leading outlet main to the town.

The joints of all the above described valves are planed, and the several facings scraped to a perfect surface, and they have a clear full-bore in a straight line.—*Journal of Gas Lighting.*

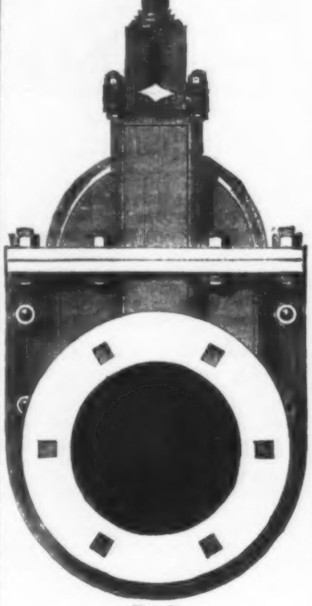


FIG. 21.

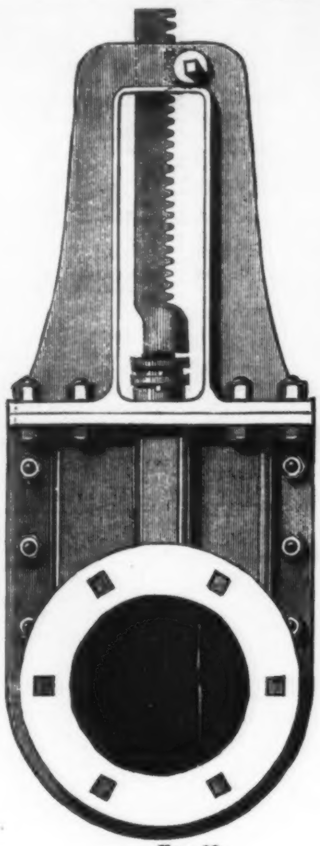


FIG. 23.

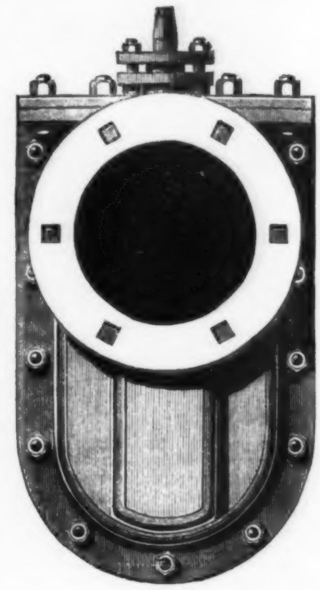


FIG. 22.

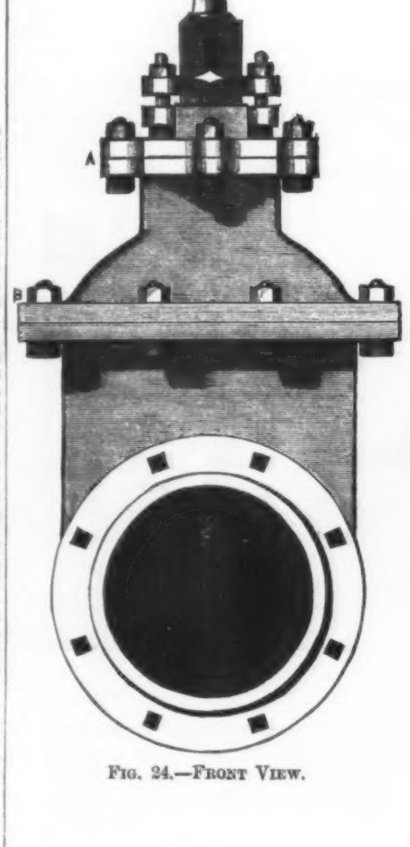


FIG. 24.—FRONT VIEW.

FIG. 25.

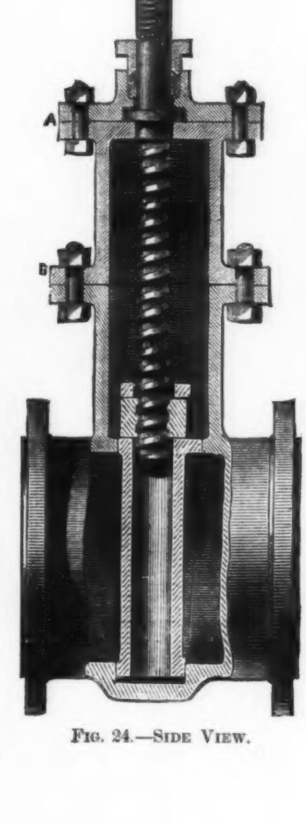


FIG. 24.—SIDE VIEW.

VALVES FOR GAS AND OTHER PURPOSES.

BLASTING JELLY AND OTHER EXPLOSIVES.

A LECTURE was lately delivered by Mr. Robert R. Tatlock, F.R.S.E., F.C.S., "On Modern Explosives and Blasting Agents," the introductory one to the chemistry course in the Glasgow Mechanics' Institution. The lecturer described, at great length, the manufacture, properties, and applications of the leading practicable explosives, but dwelt more particularly on what might be termed the three rivals—gunpowder, gun-cotton, and dynamite. These substances were contrasted with each other as regards their relative safety in manufacture, transit, storage, and use, and the physical condition and dynamical effects of each were fully discussed, as well as their respective cost. He gave it as his opinion that gunpowder was much more liable to explode by concussion than is generally supposed, and that most experiments which had been made to prove the contrary, such as firing rifle bullets through barrels of gunpowder, were erroneous in principle, the substance not being sharply jammed between metallic surfaces, as it might be in a railway collision. On the other hand, he held that dynamite was not the sensitive substance it was generally understood to be, as, if it were, it would be impossible that the large quantity of 6,000 tons could be made in a year without accident. Taking the power of dynamite at the moderate estimate of four times that of average blasting powder, this quantity would be equal to 24,000 tons of the latter per annum, or an entire year's consumption of powder over the whole continent of Europe. It was stated that dynamite was freely conveyed by rail on the continent without accident, while in this country the railway companies had refused to carry it, thereby depriving their revenues of many thousand pounds a year, hindering the progress of large contract works in which its use was indispensable, and fostering the clandestine conveyance of the substance by private individuals. The lecturer held that the refusal to carry it was the result of a misconception of its real properties, and a want of knowledge of the opinions, based upon statistics and experiments, held by the highest authorities, as to its degree of safety as compared with other explosives. The new explosive patented by Mr. Nobel, called "blasting jelly," also received some notice. It was said to be equal in power to liquid nitro-glycerine, and had the advantage of being a stiff, plastic substance, and not more sensitive to powerful concussion between metal surfaces than dynamite. In speaking of the energy developed by explosion, it was pointed out that its source, like that of all other terrestrial forces, was the sun.

THE WREN GAS WORKS.

We illustrate herewith an improved system of manufacturing illuminating gas from crude petroleum, which is cheaper and of higher candle power than ordinary coal gas, and in the production of which apparatus which is both simple and easily managed is employed. Tests made in our presence showed that a 6 foot burner, consuming Brooklyn city gas, gave less light than either a 1-foot or $1\frac{3}{10}$-foot burner using the petroleum gas, pressures being the same in both instances.

The common objection to oil gas is that it does not come to the consumer in the shape of permanent gas. That is, the hydrocarbon is not fully gasified, but is rather in a semi-vaporous state; consequently the gas leaves a deposit in the pipes, and smokes when burned. In the present system this difficulty is claimed to be obviated by the construction of the retort used, which is divided by longitudinal partitions into chambers. The oil entering one of these is vaporized, and the vapor then passes through the retort from end to end four times in traversing the compartments. As a large sized retort enters six feet into the fire, it will be seen that the gas traverses 24 feet of heating surface, and in doing so it changes from vapor into a permanent gas.

The engravings given herewith exhibit plainly the arrangement of the apparatus. Fig. 1 shows the construction suitable for fixed works. Fig. 2 represents a portable arrangement. The crude petroleum is held in the receptacle, A, Fig. 2, and thence passes, by the pipe shown, into the inverted siphon, B, which communicates with one of the chambers of the retort which is imbedded in the furnace. It will be noticed that this construction effectually prevents any danger of explosion of the retort, because as soon as the stand pipe chokes, the pressure in the retort meets the entering oil and stops the inflow—the oil running over the funnel of the siphon. Consequently no more oil can get in and no more gas can be made until the excessive pressure is relieved. The tand pipes conducts the gas to an ordinary washing vat, C, and thence it goes to the receiver.

We are informed that such an apparatus as is exhibited in Fig. 1, the retort being 6 feet in the fire, 13 inches high, and 17 inches wide outside, will produce as much as ten large 9 feet gas retorts, or 40,000 cubic feet of gas per day of 24 hours. A No. 2 retort and bench complete, size 5 feet, 6x4 feet, and height 6 feet, is claimed to make the equivalent of 25,000 feet of coal gas per day, or sufficient to supply a village of from six to eight thousand inhabitants, the works being run continuously day and night. If more gas is required two or more retorts can be placed in the same bench, the labor and fuel used being no greater. To produce petroleum gas the equivalent in illuminating power of 25,000 feet of gas, using the single retort, the manufacturer states that 300 lbs. of coal will be consumed in the 24 hours' continuous run. So that the cost of making the gas will stand as follows:

50 gallons of petroleum, at 6 cents	$3.00
¼ ton of coal at $8 per ton	2.00
Labor	4.00
Total	$9.00

This averages 36 cents per 1,000 feet of 80 candle gas. Actual practice has shown that over 4,000 feet of gas of the above candle power can be made from one barrel of crude petroleum which, even at the high rate of 10 cents per gallon, brings the cost of the gas to $7 for 4,000 feet. "This," says one user of the system, "gives a better light than $70 worth of coal gas at $3 per 1,000 feet." We are further informed that the gas is unaffected by temperature, and that it retains all its properties over an indefinite period. It has been stored in a cylinder for four years, and at the end of that period it was found to have left no deposit and not to be impaired in its illuminating properties. It is well adapted for enriching coal gas of 11 candle or other low power. One part of petroleum gas to 5 parts coal gas makes a 17 candle light; 4 parts a $21\frac{1}{2}$ candle light, and to 3 parts a 30 candle light. It is also suitable for heating purposes, and especially so for iron and steel working, owing to its freedom from sulphur.

The system is in use in Ashtabula, Ohio, where it supplies the town, the gas holder containing the equivalent of 50,000 feet of coal gas. Also in Shelbyville, Ind., Morris, Ill., and elsewhere, where its employment, we are informed, has proved uniformly successful.

Fig. 2.

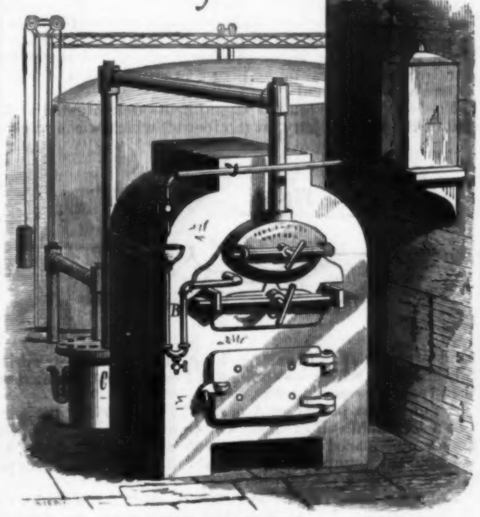


FIG. 2.—THE WREN PORTABLE GAS WORKS.

For further information address Dr. W. C. Wren, Wren's Gas Works, corner of Jay and Water streets, Brooklyn, N. Y.

FIG. 1.—THE WREN GAS WORKS.

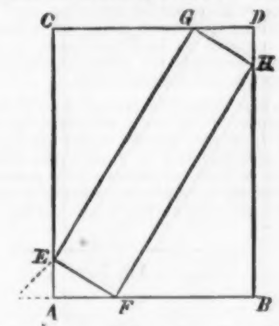
NEW SUSPENSION BRIDGE.

THE Pacific Bridge Company are building in Mendocina county, California, at Cottoneva, a suspension bridge which is described as follows: The distance from centre to centre of the saddles on the towers is 270ft. The deflection or fall of the cable is 23ft. 6in. The cables are built in the same manner as those of the Clifton bridge, at Niagara. The steel wire is about No. 11 Birmingham gauge, and is protected against rust by immersing in a bath which gives it a fine coat of zinc. There are eleven wires in each strand, seven strands in each 1¼in. rope, and seven ropes in each cable. The ropes are not twisted together to form the cables, but gathered up every 6ft. by the suspender bands. Each rope it warranted to bear a strain of sixty tons. It is made fast on an independent anchor bar, 1in. by 3in. in diameter, and forming links 18ft. long, until connection is made with the anchors. The anchors are of cast iron, 3½ft. by 3ft. in surface, weigh 1000lb. each, and are placed 14ft. below the surface of the rock. Great care was taken in securing these anchors in place by means of cross I beams which run under the rock on either side. The lower part of each pit was enlarged so as to form a hemispherical chamber, and the rock work, set in Portland cement, which is built upon the anchor, is so constructed that the upward strain is transmitted to its sides. The towers are of red wood. There are four posts 10in. by 10in., and two 10in. by 12in., giving an effective area of 640 square inches to withstand the strain of the cable on the tower. The wooden truss to prevent vertical vibration is 8ft. high and of the Howe truss pattern. The 270ft. of the bridge is divided into 45 panels. The longest suspenders, forty-four in number, are of ⅜in. steel wire, the forty-two shorter ones are of 1¼in. solid iron. The estimated dead load of the bridge is 1000lb. per linear foot; live load, one ton per linear foot; in all, one and one-half tons, or one-fifth of the actual breaking load.

THE HOWE TRUSS ANGLE-BLOCK.

To the Editor of the Scientific American:

Sir:—Several years ago an eminent engineer informed me that in the construction of the Howe truss the height and width of the panel being known, no way had yet been found for calculating the dimensions of the angle block. I have since learned that more than one engineer had been baffling



with the solution of the problem. I now forward you a simple formula and the mode I obtained it.

In the figure, let the rectangle A B C D be the panel, E F G H the brace, of which we know the width E F, then A E F is one half of the angle block.

A C = a = height of panel.
A B = b = width " "
E F = c = width of brace.
F G = l = length " " (unknown).
A F = y = leg of angle-block.
A E = x = height of angle-block,

It is evident the brace E F G H is the largest rectangle whose width is equal to E F which can be inscribed in the rectangle A B C D. Then proceeding according to the rules of maxima and minima, we have the function

$$z = lc;\ \text{let } z^2 = u, \text{ then}$$
$$u = l^2 c^2$$
$$l^2 = (a-x)^2 + (b-y)^2 = a^2 - 2ax + x^2 + b^2 - 2by \times y^2$$

Now $c^2 = x^2 + y^2$ or $y^2 = c^2 - x^2$, and $y = \sqrt{c^2 - x^2}$

Substituting and reducing

$$u = [-2b\sqrt{c^2 - x^2} - 2ax + a^2 + b^2 \times c^2]\,c$$

By differentiating and omitting the constant factor, c, we have

$$\frac{du}{dx} = -\frac{2bx}{\sqrt{c^2 - x^2}} - 2a$$

Placing this first differential coefficient equal to zero, we have

$$-\frac{2bx}{\sqrt{c^2 - x^2}} - 2a = 0$$

$$\text{and } x^2 = \pm\frac{a^2 c^2}{b^2 + a^2}$$

$$\frac{d^2u}{dx^2} = \frac{-2bx}{\sqrt{c^2 - x^2)^3}} \text{ is the 2d differential coefficient.}$$

The plus result of x in the first differential coefficient must make the above minus or a maximum; because a plus value of x in the numerator makes a minus numerator while the denominator will be plus, no matter what may be the value of x as c is positive, it being the hypothenuse of a right angled triangle of which x is a leg and hence smaller.

$$\text{Then } x^2 = \frac{a^2 c^2}{b^2 + a}$$

$$y^2 = \frac{b^2 c^2}{b^2 + a^2}$$

x and y are the dimensions required.

Mt. Pleasant, Pa. A. C. HAVERSTICK.

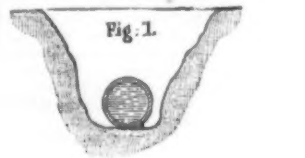
THE REMOVAL OF SAND BARS.

*On some Experiments made at Boulogne-sur-Mer, in France, upon a New System proposed for Removing the Sand Bars at the Mouths of Sea Harbors.**

By M. CH. BERGERON.

AT the last meetings of the British Association at Bristol and Glasgow, I had the honor to explain before the members of Section G a new system for removing sand bars. I was able to describe experiments made on a small scale near Paris with some sand of the River Seine. In those experiments we could ascertain the effects produced on the sand by jets of water in two different states:

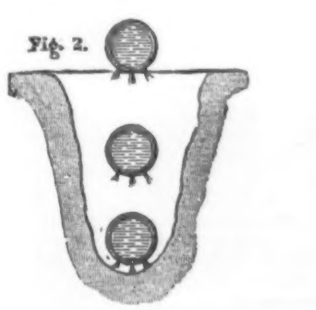
1. An iron pipe pierced in several rows of small holes of about one-quarter of an inch diameter, imbedded at the bottom of a sandbank, and in which we sent some water from an elevated reservoir or from a pump with a pressure of about 10 lb. or 12 lb. per square inch, produced artificial springs, raising the sand above, carrying it away, and producing a large and deep cutting above the pipe. (Fig. 1.)



2. The same pipe simply laid down on the sand at its surface rapidly sank down into the cutting produced through the sand by the jets of forced water coming out of the pipe and washing it away. (Fig. 2.)

Experiments of the same sort and with similar results were made in London by a friend of mine, Mr. Valentine Bell, C. E., at Messrs. Tylor's workshops in Newgate Street.

After that, I did not hesitate to propose to the French Government a trial of my system upon a large scale. I explained that if in a sand bar which obstructs the entrance of a sea harbor (Fig. 3), I could make several cuttings, *a b, a' b', a'' b''*, by means of ranges of pipes described above, in which large quantities of water should be sent from pumps or elevated reservoirs, all the sand would be put in suspension by the jets, washed by the strong currents of the tide or of the



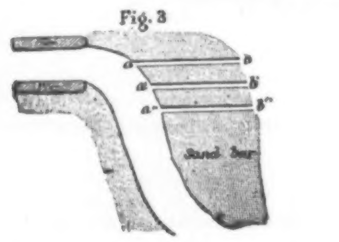
chasses, and be carried away to the deep sea, while the channel would be obtained through the bar as large and as deep as it is in the harbor between the two jetties.

At the instance of MM. Maitrot de Varennes, Inspector Général des Ponts et Chaussées, L. Vauthier, Ingénieur des Ponts et Chaussées, and Ad. Chérot, civil engineer in Paris, the Minister of Public Works decided that an experiment should be made by the engineer-in-chief of the Boulogne harbor upon a part of the bar which is entirely dry at low water of spring tides.

It was agreed that the sinking of the pipes by the mere effect of the jets or artificial springs should be well ascertained and measured upon a dry track of sand, that we might be able to appreciate afterwards its effect with the pipes deposited in the channel in the direction of the current of receding tide or of the *chasses*, of which I must say a few words.

Behind the bridge on the River Liane, at Boulogne, which connects the northern part of the town with the railway station, is an immense reservoir of more than 50 acres in surface which is filled by sea water at the spring high tides.

Immediately after the tide begins to fall, the openings are



closed with strong doors and the reservoir, which contains about 1,000,000 of cubic metres, is kept full till low tide. At that moment, by a very quick and simple process, the doors of the locks are suddenly opened and an immense cataract is produced under the bridge, all the contents of the reservoir fall with impetuosity like a river, fill the harbor and run into the sea, carrying all the sand and mud in a loose state which are in its way.

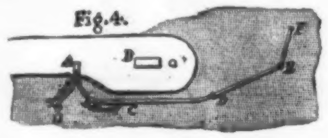
As long as the water falling from the reservoir called the *reservoir des chasses* is maintained between the two piers, it produces the same effect as a river and keeps the bottom deep in proportion to its velocity and its volume. But immediately after passing the end of the pier it expands itself upon a large surface of the sandbank, and runs in small and numerous streams in every direction right and left, and at a distance of about 500 metres from the end of the western pier, we see a large yellow track of sand, perfectly dry at low water, upon which the *chasses* have not the least effect.

It was with the hope that my system could be employed for making a cutting and that the current of the *chasses* could produce in it the same effect as between the piers, that the Minister of Public Works decided on its trial at Boulogne.

The experiments lasted a couple of months—March and April of this year—but unfortunately the credit of 10,000 francs, or 400*l.* sterling, put at the disposal of the Engineer-in-Chief of Boulogne, was exhausted before their entire completion. Nevertheless, they were able to demonstrate that the sand of the bar could be easily removed by jets of water or springs passing through the holes of the pipes in contact with it, and in which a large amount of water was sent by a centrifugal pump placed at an elevation of 7 or 8 metres above the sand.

The site chosen for the experiments was situated at the end of the western jetty, at the foot of which was a track of

Fig. 4.



sand of more than 60 metres long, quite dry at low spring tide and upon which we could stand on our feet during more than two consecutive hours.

A pump was placed at A upon the masonry of the pier, and a locomobile B of a sufficient power of from 12 to 15 horses was placed on the platform at 3 metres above, for working the pump, which was able to throw 100 litres per second. (Fig. 4.)

From the pump, about 50 metres of ordinary iron pipes of 12 in. diameter, A C D, were laid down along the foundation of the pier, and about at the same level as the sandbank.

The conduit which was to be tried, D F, was composed of pipes pierced with three rows of small holes of about ¼ in. diameter, at 10 centimetres distance from each other, connected together by rigid sections of 10 metres each, and 4 flexible joints. The length of this conduit was 40 metres.

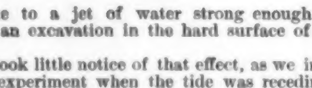
The pipes were laid down on the sand after having been bolted to the plain conduit A C D.

The extremity F was closed by an iron plate, so that all the water pumped into the pipes was to escape through the small holes of the conduit D E F, in contact with the sand.

When we were ready to start, the locomobile and the pump were put in motion. The water was extracted by an exhausting pipe A G from the channel, and driven into the conduit. The first part of it was almost vertical, being tied by iron rings to a wooden pile of the pier, and the remaining part of conduit C D E F G, of about 90 metres in length, was almost horizontal.

At first we began to try the pumps before the rising of the tide, and we observed that every hole in the pipes was

Fig. 5.



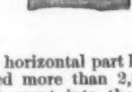
giving issue to a jet of water strong enough to pierce and make an excavation in the hard surface of the sandbank.

But we took little notice of that effect, as we intended to make the experiment when the tide was receding, for the reason that the sand raised by the jets ought to be taken away by the current of the tide or of the *chasses*.

When the tide began to rise all the pipes were soon covered with water. We could observe that the sea waves had no effect upon the state of the conduit. At the end of the operation the pipes were found to have kept the same position they had before, but their internal condition had altered.

When the tide was rising the water of the sea filled the

Fig. 6.

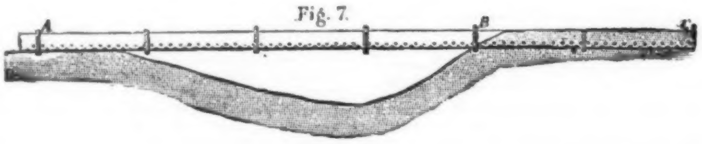


conduit, which in its horizontal part had nearly 90 metres in length, and contained more than 2,000 litres in capacity. All the water which went into the pipes was obliged to pass through the holes in contact with the sand, and according to the height of the tide, it ran with a certain speed and carried with it a large quantity of sand which filled more than half of the pipes, when the pump began to work.

We assumed that the section of the pipe at that moment was as shown in Fig. 5. We admitted that a certain quantity of sand would penetrate into the conduit, but we believed that the water from the pumps with high pressure should have washed that sand away: but to our great surprise the small particles of gravel contained in the sand filled every hole in the pipe, which was thus choked, and prevented the exit of water. No effect was produced by the jets on the sand; we found afterwards that nearly three-fourths of the holes were entirely stopped or choked by the gravel, and we were obliged to use a chisel and hammer to get rid of that gravel.

We were naturally inclined to suppose that the size of the holes was too small, and we decided to reduce their number and increase their diameter to 20 millimetres instead of 7 millimetres which they were before.

Fig. 7.



Even with such alteration the sand could not entirely get out of the conduit. The holes of a diameter of 20 millimetres were choked at the extremity, and on almost the half of the conduit the pipes were full of sand (Fig. 6), exactly as if they had been filled with concrete put by a mason for preventing the passage of any drop of water. But the pumping was able to wash all the sand contained in the front part of the conduit; the holes became free, and the jets of water produced a deep cutting under the pipes at the beginning of the conduit, as is represented by the following figure. All the sand accumulated in the conduit during the rising tide was carried by water from the pump to the extremity B C, of which not only the small holes but the total section of the pipes was filled with sand, compressed in such a state that, after having taken off the plate C and using all the pressure of water from the pump, we could not drive away the cylinder of sand B C. (Fig. 7.)

But the section A B, free from sand, was able to work and produce all the effect which was expected. The holes gave issue to a great number of jets, which made under them a sort of basin of nearly 2 ft. deep, and broad in proportion, upon which the pipes were suspended. It is obvious that if the end of the conduit B C had not been choked, we should have obtained with it the same effect as with the section A B, the entire conduit A B C would have fallen into the cutting made under it, and we should have obtained the longitudinal section which was the aim of our experiments.

We were for a moment disposed to believe that there was no remedy for the introduction of the sand into the pipes during the rising tides, unless the pump was continually working, which would be too expensive, or using large valves opened at the rising and shut at the fall of the tide. By such valves, in several places at their top, the pipes would be filled without having the water passing through the holes and carrying the sand with it.

But after due reflection, I found a much more simple process for solving the difficulty. We used small conical pipes of thin metal (Fig. 8), having a section of 1 in. at the

Fig. 8.

bottom, and ½ in. at the top. They were introduced and soldered in the holes of the cast-iron pipes, as they are marked on the figure.

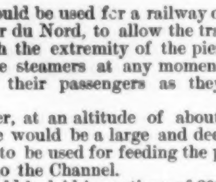
On account of the conical shape of the small pipes *a b, a' b'* (Fig. 9), when the tide rose, the sand found great resistance in its almost vertical ascension; the water percolated through it, and very few particles of gravel were able to reach the summit *a a'*, whilst the pressure of water from the pump was driving out any sand that there might be in the conical pipes.

When we tried a few pipes of this description, we found not a single hole stopped, nor was any pipe choked with sand, and I am convinced that the main difficulty of the problem was solved by this very simple and efficacious addition. In my opinion we do not want more proofs than those described above to demonstrate the efficacy of my system for cutting the sand bars.

After having explained, with the experiments of Boulogne, the principle of that system, I will try to give a description of the apparatus by which it can be safely and economically carried into practice.

I take the liberty to submit to the appreciation of the members of this section the plan which I have proposed to

Fig. 9.



the French engineers of Boulogne, which was sketched and drawn by my friend Mr. Valentine Bell, C. E., of London, according to my own suggestions. (Fig. 10.)

I propose to prolong the western pier of Boulogne to a length of about 600 metres by the means of cylindrical cast-iron piles similar to those sunk in sandbanks by Mr. Brunlees for the viaducts of Morecambe Bay and the pier of Southport.

The platform would be used for a railway connection with the Chemin de Fer du Nord, to allow the trains arriving at Boulogne to reach the extremity of the pier, which will, I think, enable large steamers at any moment of the tide to load and unload their passengers as they can now at Dover.

All along the pier, at an altitude of about 6 metres over the platform, there would be a large and deep canal always kept full of water to be used for feeding the pipes laid down in several rows into the Channel.

These pipes would be laid in sections of 300 ft. long, every section being separately supplied from the canal. The canal would be continually filled by means of a large pump raising the water from one of the floating docks of the town. It would perhaps be better to have near at hand on the shore a special reservoir containing a large provision of water raised by pumps working continually. It would be kept always full, and by sluices of large size its waters would be carried in great volume to the canal of the pier for the purpose of meeting any contingency for properly feeding the pipes imbedded in the sand at the bottom of the Channel, which pipes have for their object to remove the sandbar as I explained before.

I am perfectly certain that during the *chasses*, which last about half an hour, and produce a strong current in the harbor between the jetties, if we can successively open the communication of our elevated canal with all the pipes laid down at the bottom of the channel, we could easily at the

* Read before the British Association

same time carry away to the deep sea all the sand accumulated above. I think it useless to give greater details of this plan, which will be easily understood by engineers.

I will complete my communication by the addition of some improvements which I have been thinking of for a long time and which have not been indicated on Mr. Bell's drawing.

The first part of the new jetty is to be made *a claire voie*, that is to say, freely open to the current of the tide. The sand raised by the current would pass through the cast-iron pipes and would have no tendency, as it has now at all our ports to accumulate at the end of the pier, and form a bar across the entrance of the harbor. Naturally the bar of Boulogne would be reduced in size when the sand was brought in a very small quantity by the rising tide; gradually it would be suppressed by the use of our elevated canal over the pier and of the pipes imbedded permanently in the bottom of the channel.

I propose for a length of about 120 metres, or 400 ft., the new pier at Boulogne should be increased at the end with

Fig. 16.

large iron plates like the sides of an ironclad, able to resist the most violent action of the waves, as in the case of the granite Admiralty Pier of Dover.

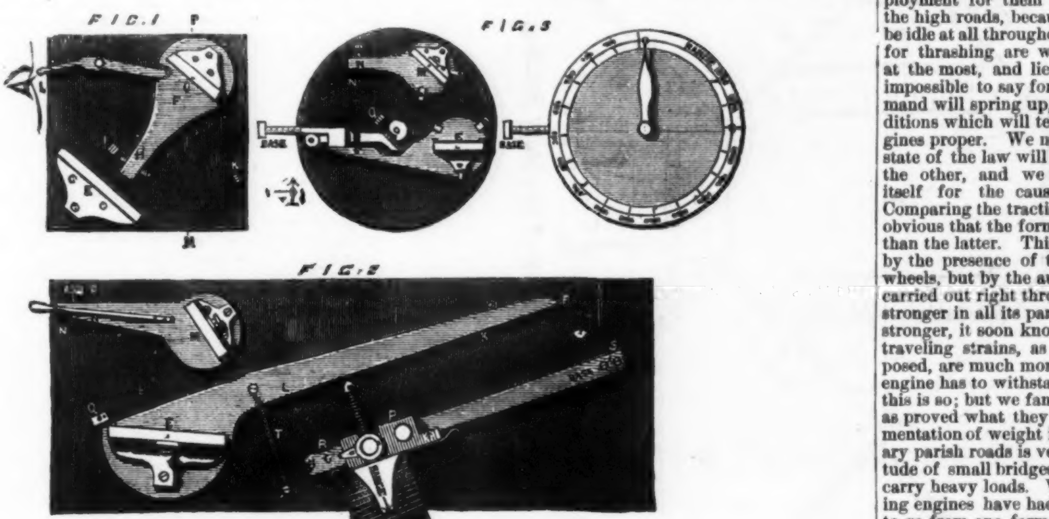
Such a pier, or I should say such a sunken ironclad, would offer an excellent shelter to the seamen in the middle of the sea, behind which the steamers could embark and disembark their passengers and goods on one side or on the other, according to the state of the sea and the direction of the wind, as it can be done at Dover.

The comparison which I have just made between the end of the pier and a sunken ironclad, the convenience to protect the ships against strong winds blowing into the harbor, brought to my mind the idea of completing my scheme by the addition of another iron wall perpendicular to the jetty, which would be paid for by the Admiralty, as a strong fortification containing all the implements for defence and the best armaments for the use of military engineers.

Behind such a wall incased by plates of the largest size and thickness, they could put in position of firing at any moment of emergency, four or five guns of 80 or 100 tons, which would prevent any man-of-war of any enemy from approaching the Boulogne harbor.

IMPROVED RANGE FINDER.

We illustrate the range finder of Capt. H. S. S. Watkin, R.A. The optical square, Fig. 1, with the covering removed, is a square or circular plate of metal, or other material, having an index glass, E, of a sextant screwed on to it. The horizon glass, G, is fixed on to a piece of metal, F H, capable of pivoting round the center, G. At the end of the arm, H, and at right angles to it, is a steel screw, conical at both ends, with a square shoulder; on the bed plate are soldered two metal blocks, T and K, so arranged that the total possible traverse of the arm, F H, with its screw, is an exact angle of 45°. It follows from this, no matter what the position of the screw, H, whether screwed in or out, the total traverse of the arm will be the same, for as the end towards the block, T, is withdrawn, the point towards the block, K, advances exactly the same amount, and *vice versa*. Should then the arm, H, be pressed by a spring against the block, T, and the eye applied to the position, L, the horizon glass may be so adjusted by the screw, H, with the aid of a key (fitting on to the square shoulder) that the images of a distant object as seen by double reflection and by direct vision shall



IMPROVED RANGE FINDER.

be coincident in the same manner as adjusting a sextant. Now, if the arm, H, be pressed against the block, K, and the eye applied at the point, M, objects, O, will be seen by double reflection, and those at right angles to them by direct vision in the direction, P; thus an optical square is produced which admits of an adjustment to an exact right angle without the aid of any other instrument, should the mirrors be at any time displaced or taken out. This method can be applied with equal facility to the index glass, and also to non-reflecting instruments.

The application of this principle to the common sextant, enabling angles to be read up to 180°, or more if required, will be easily understood from the following considerations: If in the ordinary sextant the limb be at 0°, the horizon and index glasses will be parallel to one another, and thus the same object will be seen by direct vision and by double reflection. If the former be now moved through an angle of 45°, and the position of the eye also shifted as already described for the optical square, objects subtending 90° will be seen to coincide. Should the limb be now moved along the graduated arc, objects subtending angles from 90° to nearly 180° can be made to coincide, the reading on the arc, plus 90°, being the true angle subtended.

The range finder, Fig. 2, consists of a bed-plate with an arm, E F, pivoting at E, on which is fixed the index glass, the prolongation of the side, L K, passing through the pivot, E; M, the horizon glass screwed to an arm, M N, and having a screw, N', as described in the optical square, playing between two blocks, O Q; V is a spring for the purpose of pressing the arm against either block, notches being provided in the cover for this purpose; a bar, R S, is fixed to the bed-plate, having a collar sliding along it; an accurately-constructed screw of a suitable pitch, having a steel end turned to a conical point, works in a block on this sliding piece; in prolongation of this screw, and attached to it, is a boxwood cylinder, U; from the sliding piece proceeds an index arm, the end of which nearly touches the upper surface of the cylinder; a spiral spring, T, tends to keep the arm, E F, pressed against the conical tip of the screw. If now the screw be withdrawn, the arm, E F, and the mirror thereupon will be moved through an angle, and the end of the index arm will describe a spiral on the cylinder. It will only be necessary to mark this spiral in degrees or minutes, or the ranges corresponding thereto (in a right angle triangle) for, say, a base of 100 yards. Now, if the sliding piece be moved up or down the bar, R S, certain positions will be found in which the same scale of angle or ranges will correspond to other bases, say from 50 to 130 yards, because the same movement of the screw will produce a different movement of the arm, E F, depending upon the distance of the point of the screw from the pivot, E.

Other forms of the instrument are constructed which in some respects are better than that shown in Fig. 2. The method of working the range finder is as follows: Two pickets (A B) at a distance of 18 ft. apart, are planted about 100 yards from an observer (C). The sliding collar being pressed up to the spot, and the cylinder turned to the 0° point, the observer looks at an object (X) the range of which is required, and moves backwards or forwards, until the picket, B, coincides with the object. As the arm, M N, has been pressed against the block, O, the angle, X C B, will be a right angle. The observer then plants a picket, and turns towards pickets, A B. The arm, M N, is now pressed against the block, Q, and the one picket reflected on to the other by revolving the cylinder. The reading will be the exact distance of B from C. The collar is then moved along the graduated bar to this distance. The observer now moves to the picket, B, replacing the arm in its original position, and looks at the object by direct vision. By moving the cylinder the reflection of the picket, C, is made to be coincident with it. The reading will then give the exact range, the whole time occupied in taking a range (including unpacking the instrument) being a minute and a half. For long ranges and obscure objects a telescope is provided, which can be inserted at the eye-holes to obtain exact coincidence, the approximate adjustment having been obtained with the naked eye. The advantages claimed for this invention are: The ranges taken must always be correct, as any index error in the instrument is at once detected; the instrument is entirely self-contained, and capable of exact adjustment without the aid of other instruments; no calculation or mechanical calculator is required, the ranges being read direct; the instrument measures and works with any base; no tripod or stand of any description is required; great portability is obtained, as the instrument is carried in a sling case over the shoulder.

The same instrument can be adapted for infantry and naval use, and would perhaps most conveniently take the form shown in Fig. 3. The mirrors and arms are arranged as before, but for giving motion to the arm a cam may be conveniently applied. The whole is inclosed in a case much the same in size and shape as an ordinary box sextant. To the spindle of the case is attached a pointer with a 0° point and scale of yards. The method of using this instrument is the same as those already described, except that instead of turning the cylinders with its attached screw the cam is moved by means of the index arm, and the range is read off on the dial. The bar projecting on the left of the instrument actuates the sliding collar and adjusts for different lengths of bases on the screw principle, as in the other instruments; a cam has also been applied for this same purpose.

For naval purposes the bar would be adjusted for the height of the observer above the sea level, the range scale being so graduated as to allow for the dip of the sea horizon.—*English Mechanic.*

THE PORTABLE ENGINE OF THE FUTURE.

We have good reason to believe that the demand for portable engines to be used in Great Britain, which has been becoming smaller and smaller for some time past, will soon cease almost altogether. The only engines of the kind which will be built in a not distant future will be sold in foreign markets, or purchased for home use solely by builders and contractors. This statement will hardly take any of the great agricultural implement firms by surprise, however startling it may appear to others. But no alarm need be felt; an important branch of trade will not be cut off. The place of the portable engine will be filled by a kindred machine, in the production of which profits may be made, and a large business done. In order that we may understand what this machine will be—what, in a word, is to take the place of the portable engine—we must consider the nature of the circumstances which have led to the change. In Great Britain portable engines are bought—putting contractors on one side—by two distinct classes. One of these consists of men farming large tracts of land and possessing two or more homesteads, often some miles apart. These agriculturists use the portable engines almost exclusively for thrashing; and the engine and machine have to be moved as occasion requires from farm to farm. The removal will require, on an average, the services of six horses—four to draw the engine, and two to draw the thrashing machine. The horses are taken for this purpose at a time when every hour is of importance to the farmer who wishes to get his land ploughed, or his roots led home; and this the owner of the engine, machine and horses regards as a serious evil. The second class of British purchasers consists of men who either hold no land, or very little. They invest some hundreds of pounds in the purchase of one or more sets of thrashing machinery, and they make a livelihood by hiring them out to farmers who do not grow corn enough to give employment for more than a few days in the year to a thrashing machine. The rule is that each hirer of the set shall send his horses for it to the place where it was last employed. If the tiller of hundreds of acres grumbles at the loss of the services of six horses for a day or two, how much more inconvenient must the loss of his teams prove to his poorer neighbor? The difficulty of the case is of course augmented when, as sometimes happens, the small farmer has not got six horses to send for the engine and thrashing machine. So long as there was no help for this state of affairs, the farmers had perforce to submit. But he has not been blind to the fact that certain owners of the machinery which he wanted did not use portable but traction engines; and for a very small extra hire—sometimes without any additional cost whatever—engine and machine came together to his stack-yard, thrashed as much corn as he wanted, and went away without at all interrupting his field work. The result is that he who possesses a traction engine always has the pick of the market for his thrashing machinery; and it has already been discovered that it will not pay to purchase portable engines to be hired out, while a neat little income can be realised if the engine will propel itself and a thrashing machine from farm to farm. The holder of great tracts of tillage land finds precisely the same benefit result from the substitution of the traction for the portable engine, and it is thus day by day becoming more evident that those who wish to build agricultural engines for sale in this country must give them self-propulsion.

Are we then to believe that the traction engine will take the place of the portable engine? The answer to this question will depend altogether on certain conditions, and bearing this in mind, we may say that it is not unlikely that a demand will exist for two classes of engines. The large landholder will probably prefer a portable engine fitted with self-propelling gear, because such an engine will be lighter, simpler, and cheaper than traction engines. But those who purchase engines that they may hire them out will prefer traction engines whenever it is likely that they can get employment for them in hauling coal, corn, manure, &c., on the high roads, because in such cases the engines need hardly be idle at all throughout the year, whereas engines fitted only for thrashing are worked for but a couple of months or so at the most, and lie by for the rest of the time. It is quite impossible to say for which class of engines the greatest demand will spring up, but it is not difficult to define the conditions which will tend to limit the demand for traction engines proper. We may assume, for the moment, that the state of the law will exert no material influence one way or the other, and we must look therefore to the machine itself for the causes which will affect its popularity. Comparing the traction engine with the portable engine, it is obvious that the former is, for a given power, much heavier than the latter. This increase of weight is caused not only by the presence of the gearing required to drive the road wheels, but by the augmentation in strength which must be carried out right through. A traction engine ought to be stronger in all its parts than a portable engine. If it be not stronger, it soon knocks itself to pieces on the roads, as the traveling strains, as we may term them, to which it is exposed, are much more severe than those which the portable engine has to withstand. It would be easy to explain why this is so; but we fancy our readers will be content to accept as proved what they very well know to be true. Now augmentation of weight in engines intended to travel over ordinary parish roads is very objectionable, because of the multitude of small bridges and culverts which are far too weak to carry heavy loads. We could cite instances wherein ploughing engines have had to make a round of six or seven miles to go from one farm to another not more than a mile off, in order to get to a bridge strong enough to carry them. It may be said that the bridges ought to be made strong enough. We shall pronounce no opinion on this point; but whether they ought to be strengthened or not, it is at least certain that there are large districts of country in which at present the use of any engine weighing more than 6 tons is almost impossible, because of the weakness of certain parish road bridges spanning small streams. Another factor tending to limit the demand for traction engines is found in the cost of repairs, which it is not too much to say never comes to a sum less than twice as much as would suffice to keep a portable engine in excellent order, while it is as often five times as great.

If, now, we compare the self-propelling engine with the traction and the portable engine, it will be seen that several points may be urged in its favor. In its simplest form the self-propelling engine is an ordinary portable a little strengthened in a few places. On the crank shaft is fitted a chain pinion. The hind-axle revolves in bearings at the back of the fire-box, and is driven by a chain wheel keyed on it. The road-wheels are caused to revolve by shifting pins in the usual way, which pins can be removed at either side when a sharp corner has to be turned. At the back of the fire-box is hung a kind of removable tray or foot-plate for the driver

which provides room for about 1cwt. of coal, any additional quantity required being conveyed in bags on the thrashing machine. Water is carried in a tank under the barrel of the boiler. Engines of this type were built several years ago by Messrs. Barrett, Exall & Andrewes, of Reading, and possibly by other firms, and answered very well. At the time, however, no sufficient demand had sprung up for self-propelling engines, and but few were made. Of such engines it may be urged that they can be much lighter than a traction engine. So much lighter, indeed, that any bridge which will carry a portable engine may be trusted to sustain one. They will also be cheaper as regards first cost and repairs than a traction engine. But on the other hand, it must not be forgotten that their use will be practically limited to the performance of the ordinary duties of a portable engine, and they will be unfit to draw heavy loads. The intending purchaser will no doubt bear these facts in mind, and decide which class of engine will best suit his purpose; but agricultural engineers may feel certain that for both kinds of engine a large demand will spring up ere long. Out of the manufacture of which class of engine the greatest profit may be made we cannot pretend to say. But it would appear that before laying himself out for the production of either the one or the other, the engineer should study the nature of the district in which his customers live, and shape his plans accordingly.

It is not improbable that a good market might be found for a fourth type, namely, a very light traction engine, which would be competent to convey moderate loads at a speed a little greater than that of horses, say four to four and a half miles per hour. In order that such an engine may be kept as light as possible, it should have but one speed, and either carry steam of, say 80 lb. to 90 lb. pressure or else have the cylinder made a little larger than usual, in order that sufficient power may be available when a bit of steep hill has to be surmounted. It will be essential to the success of such an engine that it is carried, as regards the driving wheels, on springs. These need not be very flexible, but their use would permit the weight of the boiler, and most of the moving parts, to be kept down to those of the ordinary portable engine. With the demand no doubt engines of this type will spring up. In a word, the traction engine and its congeners is coming once more into prominence, and so much experience has been acquired in the practical use of steam on common roads within the last twenty years, that a very successful result may be anticipated. However, some men will make mistakes, and we shall not be surprised if certain very singular examples of the self-moving agricultural engine are found in the Agricultural Hall at Islington, next December.—*The Engineer.*

NEW SCHOOLHOUSE DESIGN.

WE present a diagram for the ground plan of a two story schoolhouse, and feel confident that it will be appreciated. Here are combined, at once, strength, beauty, and convenience.

The injurious system of admitting light from only one side of the room is completely obviated by this plan. The light is here admitted just as it should be: from rows of windows arranged on either side. This arrangement of the windows furnishes also the best of facilities for ventilation. But perhaps one of the greatest advantages of this design is that the noise of one room cannot annoy the others. When two rooms of a building are separated by only a thin partition, with a door opening through, the exercises of one are often very much disturbed by singing or concert recitation in the other. But by this plan each room will be as free from noise as though it stood entirely alone. Buildings of this design may be one, two, or three stories in height, according to the requirements of the district. For a village of from eight to ten hundred, the one story form will probably be sufficient. The two story house of this pattern will be well adapted to the wants of cities of from 1,500 to 2,000 inhabitants. The broken surface of this style of architecture adds greatly to the apparent size of the building and the general appearance is much more pleasing than the plain outline of the rectangular form.

This design is not a mere experiment on the part of the architect, but is the out-growth of forty years of careful study, aided by the suggestions of some of the best educators in the land. It is the work of Mr. A. Langdon, of Winona, Minn.—*Iowa Normal Monthly.*

A—School Room. B—Platform. T—Teacher's Closets. C—Cloak Room. F—Corridor. P—Vestibule. V—Ventilator.

Drawn and designed by F. LANGDON, *Architect, Winona, Minn.*

NEW SCHOOL HOUSE DESIGN.

THE VENTILATING AND WARMING OF SCHOOL HOUSES.*

By DR. F. WINSOR, OF WINCHESTER, MASS.

THE necessity for providing in some way for a sufficient supply of pure air in every room intended for use by human beings is now admitted by every intelligent person. The question is, What is a sufficient supply, and how can it be best supplied?

What tests have we of the purity of air which are at once reliable and practically available? The senses, and certain simplified processes of chemical analysis.

If we remain in a confined air which is growing vitiated by the products of respiration or combustion, we are warned of its deterioration by a growing sense of discomfort, by dull headache, desire for a long breath, inability to attend or to enjoy. But persons who are not accustomed to a good air in their rooms are not thus warned until the vitiation has become great. It is very satisfactory to notice how nearly the verdict of the healthy and well-educated senses on this question of the purity of the air in a given room corresponds to the verdict of chemical analysis. When the latter announces the proportion of carbonic acid to be above 7 to 1,000, the former say this air is too "close;" and so on through "bad," "foul," up to "unendurable;" when the proportion of carbonic acid in the 1,000 reaches 14.

The only one of the approximate chemical tests for the purity of air which it seems to be in place to mention here is the so-called household method proposed by Dr. Angus Smith for carbonic acid; namely, "Let us keep our rooms so that the air gives no precipitate when a ten and a half ounce bottle-full is shaken with half an ounce of clear lime-water." Carbonic acid is of course taken here, as it is in treatises and papers of great authority, as the most convenient test known to us of atmospheric purity, one sufficiently exact for most practical purposes in discussing the efficiency of ventilation. Though not in itself dangerous (except in so far as it displaces oxygen), it is so seldom found in rooms used by man, unassociated with other gases more dangerous but less easily estimated, that it is accepted as the best practical exponent of the degree to which these other more dangerous and more insidious gases prevail in the air of any room. The best known among these eminently dangerous gases are carbonic oxide, sulphuretted hydrogen, sulphide of ammonia, sulphurous acid, caprylic acid, and probably a Protean host of other volatile excretions from lungs and skin. These very rarely exist in any schoolroom in a proportion so large as is common in the case of carbonic acid; but their presence is appreciated by the senses much more readily.

* Read at the meeting of the Social Science Association at Saratoga, September 6, 1877.

GERMS.

Of so-called "germs" we say nothing, save that, whatever they may prove to be, they must be least numerous and least dangerous in proportion as the ventilation is most complete. There are in addition to these gases the various forms of *dust*, organic and inorganic, from the wooden floors, the leathern shoes, the cotton or woolen clothing, the decomposing dirt of the streets which is brought in on shoes and clothes. In the ordinary ill-ventilated schoolroom this dust not only floats in the air when first liberated, and is stirred up afresh from the floor by every motion of the feet, but it clings to the walls, and is absorbed by the porous plaster, so that the scrapings of the walls of a typically bad schoolroom have when moistened yielded a horribly offensive mass of putrefaction.

STENCHES.

If any one clings to the old whim that nasty smells are not unwholesome, it is because he ignores a mass of evidence and of personal experience sufficient to convince all who are open to conviction. From the indefinable but unmistakable smell which so sticks to all hospitals (except the best modern pavilion or hospital tent and barrack), and which is found associated with a mortality closely corresponding to its pronouncedness, to the nauseating stench of a dysenteric stool,—bad odors are fraught with danger, and warn us against filth diseases. If we are told that imagination and fastidiousness have much to do with the suffering caused by stenches, we reply that children are certainly less observant of bad odors than adults, yet they are the earliest and most frequent victims to the filth diseases. A friend tells me that at a frequented seaside resort, a gentleman who had quite lost the sense of smell was warned away from the mouth of a drain, which opened near a seat on the rocks to which he liked to resort, by finding that his visits there were always followed by headache. Dissecting-room diarrhœa in students who have quite overcome the repugnance of beginning, and who are intent upon their work, is another instance in p int; and instances might be multiplied indefinitely.

If on the other hand we are told that men employed habitually about sewers, decomposing manures, animal refuse, the holds of vessels, and so forth, and not exceptionally unhealthy, we answer that extended observation does not sustain such statements; that wounds do not heal well in such workmen; and that their apparent immunity is only temporary, and is analogous to the "tolerance" of certain other poisons, which is recognized as being set up by small and repeated doses of them, but which proves only that the system is not *shocked* by an evil to which it has become accustomed, not that it is no longer harmed by it. As well assert that a man in whom phthisis has come to a stand after having disabled one lung, and impaired the other, is as well off as a man with sound lungs, because he sustains life and performs some of its duties on an allowance of air with which the latter would find himself reduced to gasping distress and helplessness.

It is wise to suspect danger wherever there is any degree of stench, and to act upon the suspicion; although it is not always safe to feel secure where no closeness or ill odor is perceptible.

ABUNDANT PURE AIR ESSENTIAL TO HEALTH.

The history of military hospitals, which has been ably and convincingly set forth in recent monographs, furnishes irresistible evidence of the necessity of pure air to good health, and proves that with abundant fresh air the sick and wounded recover, in structures so rude as scarcely to be called shelters, faster by fifty per cent. than in most substantial hospitals without it; undergoing when removed from the latter to tents, even in severe winter weather, an improvement so rapid and wonderful as to be called "magical."

It has been demonstrated that nothing so hastens the recovery of wounded and sick *men* as an abundance of pure air, but the world was a century and a quarter in learning the fact. Can it be doubted that this same pure air is the best means of preserving and brightening the health of school-children? Are we to be a century and a quarter in learning the application of this lesson to them? Will the country of free public schools grudge in every town and village the necessary outlays to keep the children's bodies in good condition while their minds are in process of educating?

CUBIC SPACE.—FREQUENCY OF RENEWAL.

How frequently it is necessary to renew the air in any room inhabited for the whole or for any considerable part of the day, and how many cubic feet must be allowed per head to its occupants, are questions which have called out the most competent investigation in all civilized countries; and the results of these investigations agree tolerably well as regards the dimensions and the frequency of renewal which should be the standard for hospitals and barracks. When these questions are raised in regard to schoolrooms, there is considerable diversity of opinion. It is agreed that such rooms, being continuously occupied but a few hours out of the twenty-four, and admitting of being well aired and cleansed during many of the remaining hours, do not require such large provision of space as is necessary in hospitals, barracks, and similar buildings. And the best modern authorities (Boese, Varunstrapp, Sanitary Committee of Philadelphia School Board, Committee of Medico-Legal Society of New York) fix the minimum between 250 and 275 cubic feet per scholar. But practice lags far behind correct theory. The English law requires the principal schoolrooms and classrooms of national schools to contain at least 80 cubic feet of internal space, and 8 square feet of area, for each child in average attendance. Kiddle and Schem's Cyclopedia of Education require at least 108 cubic feet, and 9 feet of floor space. In New York City the requirement is for 70, 80, 90, 100 cubic feet respectively in the various ranks from lowest up!

We cannot do better than to adopt Dr. Lincoln's estimate given in his paper read in this department last September, and published in the *Sanitarian* for November last; viz., 250 cubic feet per head, or (assuming the room to be 12½ feet in height) 20 square feet of floor space per head for "children in their teens." Such children need *more food* than men and women; all physiological processes go on more rapidly in them than in adults. *They should have as much room.* Primary scholars foul air more rapidly than older children in other ways than by breathing—as must have been generally observed—being less nice in their habits, and having less self-control; so that a supply of air graduated exactly on the proportion of carbonic acid exhaled by young children will be certain to prove insufficient, because this gas is not in their case so true an exponent of

the degree to which the air has been vitiated as in the case of older children and of adults. Moreover, the fact that young children, are, from the delicacy of their organization, much more quickly and profoundly affected by foul air, must make us insist upon giving their schoolrooms a generous measure of pure air, instead of cutting them down to a mathematical minimum based upon the estimate of their excretion of carbonic acid as compared with that of adults.

HUMIDITY.

The problem of supplying fresh air is, in our climate, complicated by the necessity of heating it, and in so doing, of changing other of its properties than that of temperature. We cannot take out-of-door air at a temperature of 32° and heat it to 120° or 150° without changing it from a condition of wholesome humidity to one of unnatural dryness, as is demonstrated by the shrinking and warping of the woodwork in our houses, and by a certain sense of oppression, irritation, and harshness, which many persons are only too familiar with in the atmosphere of ordinary furnace or stove heat.

Pure outer air at 30° Fah. contains, if quite saturated, 2·21 grains of water to the cubic foot. Heat it to 60° Fah., and it falls to 34·2 per cent. of saturation; to 70° Fah., and it falls to 24·6 per cent. of saturation; to 80° Fah., and its percentage of saturation is but 17, which is said to be dryer than the air of the desert. Under these circumstances it of course becomes a powerful absorbent of moisture from our bodies, especially from the pulmonary mucous membrane. It is not probable that this absorption from the pulmonary mucous membrane is absolutely harmful; witness the effect on healthy lungs of outer air at 0° Fah., which must be raised *in the lungs* in four or five seconds to 90° Fah., with a corresponding increase in the capacity for absorbing moisture, all at the expense of the lungs, which yet sustain no harm (see Derby on Anthracite, p. 28). Although opinions differ widely as to the hygienic influence of a very dry air as a general condition—*i.e.*, *without* as well as *within* doors—there can scarcely be a doubt that the alternation from the very dry and hot air of many rooms to the cold and comparatively very moist outer air, and *vice versa*, to which most of us are exposed many times a day in winter, is very trying, and is a frequent cause of disease. It is almost universally, i.e., popularly rather than scientifically, admitted, that heating apparatus should be supplied with means for hydrating the air they warm, and that this hydrating is seldom sufficiently provided for.

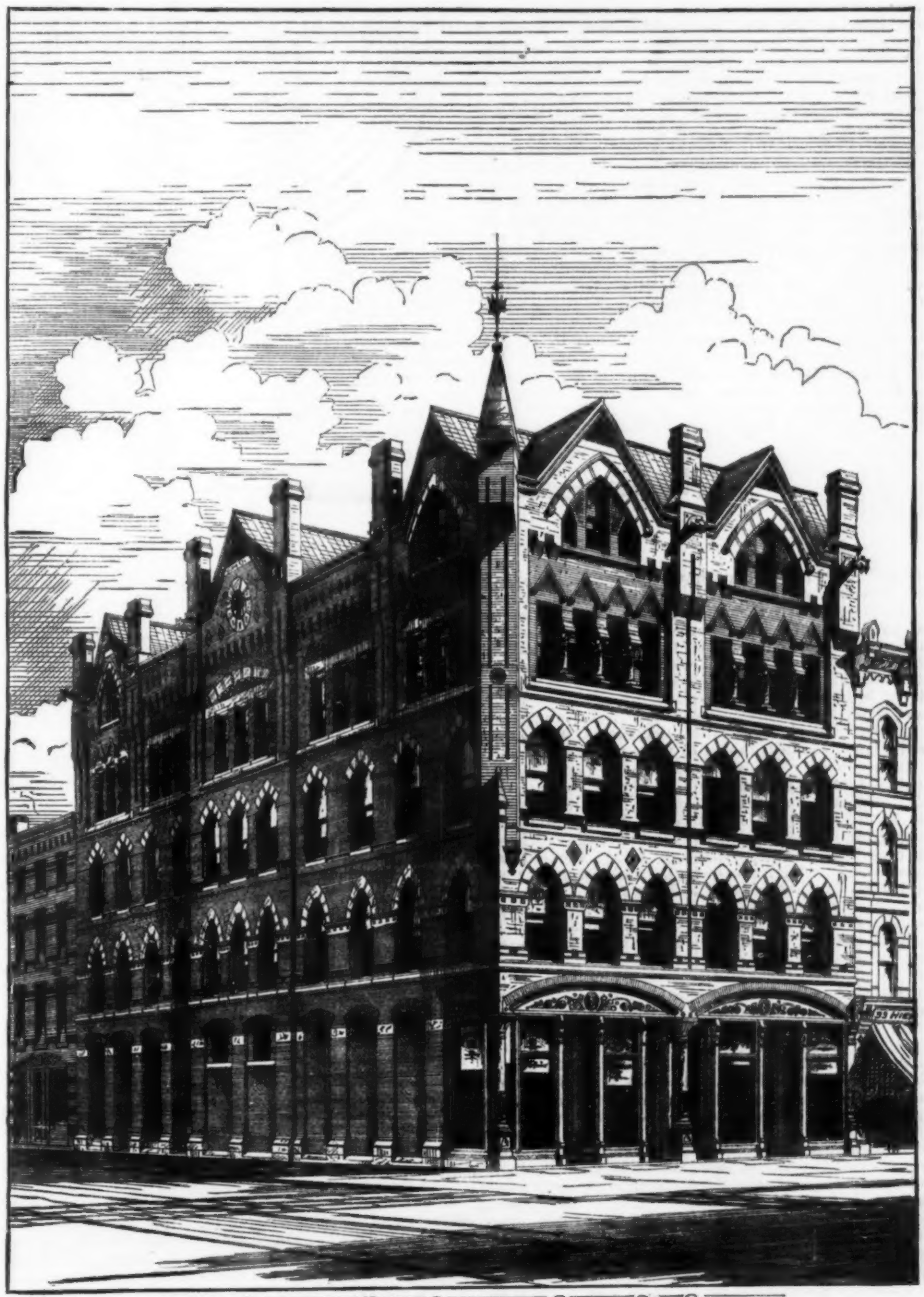
It is not so generally understood that, if we moisten the air, we may reduce by several degrees the temperature without suffering discomfort. This is certainly true for temperatures between 60° and 70° Fah. Of air above 75° Fah., it may be said that it grows less endurable in proportion to the degree in which it is moistened; and the same is certainly true of temperatures below 40° Fah., *damp* cold being harder to bear and more productive of diseases than dry cold. Moreover, it is frequently forgotten in the discussion on hydrating the winter atmosphere of our dwellings, that the very arid conditions before mentioned are *never* to be found within our rooms, whatever may be the case within the hot-air chamber of an iron furnace. Without any attempt at moistening the air we heat, it does take up a very considerable amount of water after it leaves the heating apparatus. Beside the steam from kitchen and washrooms, and contributions from every article and being in the house, it must be borne in mind that an actual though insensible passage of air is constantly occurring through the materials of the walls, be these what they may, and that this air from without has the humidity of the outer air. Consider, too, the amount of water which many building materials hold in their pores (a brick can absorb one-tenth of its weight of water), and we shall cease to wonder at the fact that the relative humidity in our dwellings is never below 40 per cent. In school and other assembly rooms it is always higher, in consequence of the watery vapor with which every human expiration is strongly charged.

Apart from the influence of moisture on our sensations, there are practical limits placed to its prevalence in our rooms by the phenomena of condensation which begin to manifest themselves on windows and on ordinary outer walls whenever the humidity within reaches the saturation point of air at the temperature of the inner surface of the glass, and we then have frosted windows, if not walls—a difficulty which can be overcome only by double windows and outer walls of proper thickness and construction. It is of course highly desirable that every schoolroom should be thus furnished and constructed, and much fuel would thus be saved; and the sanitarian should press the importance of this matter upon the community, and especially upon all officials connected with schools. But it is certain that for years to come his representations will be heeded by but few of those who have the practical direction of schoolrooms and buildings; and until public opinion is educated to the point of action, the vast majority of schoolrooms will still have single windows and thin outer walls, and their inmates will object to their being coated with water or with frost. There are some who insist that an interior atmosphere is unwholesome unless its humidity approaches the point of saturation, and that it should be at least as high as 70 per cent. of that condition. It would seem that this view ignores the well-known effect on body and mind of "dog-day" weather, i.e., of a warm air saturated with moisture; as it does, on the other hand, the effect on body and mind of climates which are permanently dry. I regret that I cannot give statistics of the observed humidity of such climates; but certain well-known facts with regard to parts of Colorado, New Mexico, and Mexico are very significant. It must be a very dry atmosphere where fresh meat can be cured by hanging it in the open air, yet these regions are notably salubrious. The same is true of certain parts of Peru and Bolivia, which are rainless, and so dry that houses are built of rock salt. Sprenger, in his life of Mahomet III., bears enthusiastic testimony to the healthful and invigorating quality of the climate of Arabia. A native of the Alps, and familiar with the Himalayas, he admits that the air of neither of these mountain chains was so strengthening or so vivifying as that of the Arabian Desert. He says: "Nowhere is a man happier than in the desert; the sky is always clear, the air even in hot weather is strengthening and refreshing; every breath we draw makes us thank God for life." Palgrave testifies to the same effect, though less enthusiastically. But the following passage contains the strongest statement as to the sanitary properties of dry air with which I am acquainted: "The Harmattan is a wind which blows from the north-east (the interior of the Sahara) to the west coast of Africa, between Cape Verde (15° N.) and Cape Lopez (1° S.), a line of over 2,000 miles, lasting sometimes one day, sometimes fourteen or more days. During its prevalence everything dries up; leaves become so parched that they can be rubbed to dust between the fingers; covers of books, though shut up in trunks, warp as if they had been exposed to a fire; household furniture cracks; panels of doors split; any veneered work flies to pieces. Another and the most striking feature of the Harmattan is its salubrity. Though prejudicial to vegetable life, and occasioning disagreeable parching effects on the human species, it is highly conducive to health. Those laboring previously under fevers generally recover during its prevalence, the feeble gain strength, and malarial diseases disappear."

Again, it must not be forgotten that moisture favors decomposition, and if we make the air of an audience or school room very moist, we certainly render more dangerous, as well as more offensive, whatever filth may be there, whether it be from dirt—commonly so styled—or from the animal exhalations of the skin and lungs; in which case it would seem that a very humid air would make ventilation more necessary, rather than less, as some of the advocates of very abundant hydration contend. Another point to be borne in mind is that every room where persons are assembled is receiving from their expirations a very considerable amount of watery vapor—from each child about 1 oz. of water per hour. This would furnish (for a school of 50 pupils) 3 *pints of water per hour*—a rate of evaporation quite equal to that from most furnaces supplied with an evaporating pan. If it be objected that this is very impure vapor, and therefore needs to be increased by so much more pure watery vapor, the reply is that it is inevitable, and is made no better by the addition proposed. It must be got rid of by ventilation. Suppose 50 children, each giving out 500 grains of water (=25,000) per hour—a suitably large room will contain (250×50) 12,500 cubic feet—and as the air is supposed to be charged three times in an hour, the total hourly supply of air = 37,500 cubic feet. Therefore there exists constantly in the air the amount of $\frac{25000}{37500} = \frac{2}{3}$ of a grain per cubic foot, coming from the children's lungs. If saturated air at 70° Fah. contains 8 grains per foot, $\frac{2}{3}$ of a grain will represent 8 per cent. added to the figure expressing the humidity; air at 50 per cent. humidity will be raised to 58 per cent. The writer is inclined to agree with Dr. George Derby that in our winters the air of a schoolroom, which does not exceed 68° Fah., requires no artificial evaporation on the score of health. It will maintain itself above 50 per cent. of saturation whatever heating apparatus is used; and in our climate, which is dry as compared with Europe, it may be questioned whether it is wise to accustom ourselves to a humidity within doors very much in excess of that which prevails without.

A NEW BUILDING, SYRACUSE, N. Y.

A VERY handsome example of commercial architecture is the new building lately erected in Syracuse, N. Y., shown in our engraving, which is from the *American Architect and Building News*. The building has a frontage of 45 ft. on North Salina St. and 100 ft. on Church St. It is built of Trenton brick, finished with Berlin, O., sandstone. Cost $80,000.



BUILDING—CORNER OF NORTH SALINA AND CHURCH STS. SYRACUSE.
ARCHIMEDES RUSSELL, ARCH'T.

DRYING PLASTERING IN DENMARK.

ACCORDING to the *Grossherzoglich Hessisches Gewerbeblatt*, a Danish architect, Mr. Kruse, of Copenhagen, has recently erected a building, and prepared it for occupancy, in forty days; the walls being dried in three days. A calculation showed that from each story there was a minimum of four thousand gallons of water to be evaporated. To do this, a great increase of temperature was necessary, and coke-stoves were placed in the cellar at the base of every chimney. One flue, probably, served for all stories. The chimneys were then closed above the roof, and a passage allowed the dense smoke by cutting openings into the flues six inches underneath the ceiling of the first story. An escape was then allowed on the level of the floor; and the rooms thus filled with currents of smoke and gases were quickly dried. This process was repeated floor by floor, the openings being successively broken out and walled up. The temperature varied from ninety-five to one hundred and twenty degrees Fahrenheit, and was, of course, lowest at the floor-level. The ventilation was so great that the air, or rather the smoke, in the room, was totally changed from five to six times an hour. Something less than nineteen tons of coke were needed for a story, though we are not informed for how many rooms. A single workman was alone employed to attend the firing. It is also stated that the wood-work remained unharmed, there being no shrinkage noticeable in the doors, windows, etc. When dry, it appeared that the wall-plaster had attained an exceptional hardness, owing, no doubt, to the great quantity of carbonic acid gas produced by the imperfect combustion, which had changed the caustic lime into carbonate of lime. So says the report. It is quite customary to burn charcoal in newly-plastered houses for the sake of the gas; but there are few attempts of so great a magnitude as this on record. It seems strange, remarks the *American Architect*, that three days of such heat, and the evaporation of such quantities of water, should not have caused the wood-work to shrink or check, as it might reasonably have been expected to crack the walls. Plaster thus dried, and

capable of absorbing little or no water, must have increased the labor of the kalsominer, paperhanger, or frescoer; the carbonic acid gas which filled the house naturally rendered superintendence impossible; and it is to be supposed that walls, ceilings, and floors were blackened by the smoke. But these are minor considerations; the great objection is that the plaster was probably only hardened on the surface. It is a well-known fact that mortar in any form does not reach its usual firmness when dried in the heat of summer even. It seems as though the presence of water were necessary to aid the combination of lime and carbon. One of the best authorities on the subject, Vicat (*Récherches sur la Chaux*) goes so far as to assert that mortars lose four-fifths of their strength if dried too rapidly. He commends the custom of the masons of Northern Italy, who, in constructions of importance, water the masonry during the summer months to guard against this danger. It is an old saying that lime at a hundred years is but a child; and such precocious forcing at birth does not appear conducive to long life.

HOW CAN THE PRESENT METHOD OF CARRIAGE-PAINTING BE IMPROVED?

By W. H. Stewart, Orion, Richland Co., Wis.

I hold, first, that the work of the carriage-painter is inseparably connected with that of the wood-worker, and that the condition of the woodwork is a most truthful precursor of what must be the final condition of the painting; for if the woodwork is improperly prepared or badly finished, it bids defiance to the painter who strives to do a good job, and it baffles any and every plan or theory that has been or may be invented for the purpose of economizing paint, material, and labor. It is well understood that in doing a good job of carriage-painting, a uniform surface must be had, and if it is not properly begun in the woodwork, but one resort is left, namely: to lay on a large amount of paint material, to fill up the dimples or depressions. See Fig. 1, in which line A A represents the surface of a panel that has two depressions, at D D, and line C C represents the surface of the roughstuff paint after the painter has cut it to a uniform surface or level. The dotted space between lines A A and C C shows the unequal thickness of the paint material that must be left on such a panel. Line B B shows the surface of the roughstuff after a sufficient quantity has been laid on to fill up the depressions, and before it has been cut down, while the space between lines C C and B B shows the amount of paint material that the painter must cut away to bring all to a level surface. It is very clear that to lay on and then cut off such an amount of waste roughstuff must cost an unnecessary outlay of material, time and labor. I think I can safely say that all painters will agree with me thus far.

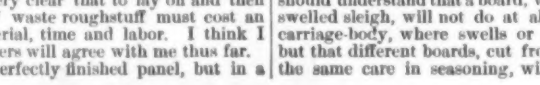


Fig. 1.

Fig. 2 illustrates an imperfectly finished panel, but in a condition the reverse of that shown in Fig. 1. Line E E represents the surface of the panel; H, a prominence rising above the general surface of the wood, and line K, the surface of the roughstuff before being cut down. Line F shows the surface of the roughstuff after being cut down, and the dotted space between lines E E and F F shows the amount of paint material that must be left over the general surface, in order to bring all up to one common or uniform level. In this case, if the wood-worker had only cut the prominence down to dotted line H, it is obvious that the job would have required a much smaller amount of paint material.

All the above facts are well understood by practical carriage-painters, and my explanation, so far as they are concerned, could have been made equally well without the figures, for they have the reality before them continually; but as a reform is called for, and as I understand that this reform must begin in the wood-shop, I have thought that, the wood-worker being accustomed to work after drawings, it would be proper to reach him in this way.

From the above it will be seen by all, whether painters or wood-workers, that in order to economize material in the rough under-coats of paint, the wood must have a proper surface.

Next, let me call attention to the fact that the waste of paint material is not the most serious loss incurred in making the surface of paint, which should have been mostly made in the wood. This body of roughstuff shrinks as it becomes older, and the amount of shrinkage is in proportion to its thickness. Thus the heavy or thick parts that the painter is obliged to leave in the low places shrink more than where left thinner, and this process of shrinking alone will ruin the surface of any job though it may be perfect in every other respect; and when the surface is lost, all is lost. Do not then require the painter to guarantee a first-class and durable job over an uneven wood surface that has compelled him to leave the under-coats of paint thick and heavy at some points and thin at others, alternately, all over a large panel, when he knows and often has warned you that such uneven under-coats must and will shrink irregularly, thus ruining the temporary surface of paint that he has been compelled to make, and when he knows also that such irregular shrinkage will have a tendency to crack the hard glazing colors under the varnish.

As to colors, we can not expect the painter to economize the coloring material more than he now does, for generally he only uses the smallest amount that will give a solid color. If less color is to be used and fewer coats, the proposed reform must then begin with the chemist or color manufacturer, and colors must be put in the market having improved covering qualities. Then, and not till then, can we reasonably ask the painter to produce the desired results with less coloring material, or with a less number of coats, or less cost of time and labor in coloring.

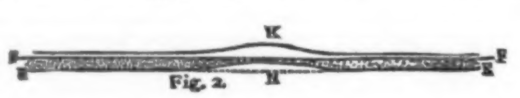


Fig. 2.

Neither can we ask the painter to economize material in varnishing more than he now does; for the experience of all proves that a certain number of coats of the best grades now in market is absolutely indispensable, to give the desired results.

Let me here remind all of the lesson left on record for us by Mr. Henry F. Porter, namely: "*Calculate closely every part of the carriage before it is made.*" Let us try to profit by this suggestion, by closely calculating the end from the beginning, particularly when we are getting out and working the wood. Please pardon me again, then, while we take our leave of the paint-shop for a short time, and retire to the office, to make a little of Mr. Porter's close calculation. Let us see if we can give a suggestion or two, and perhaps a drawing, that will prove of service to the body-maker, that he may not only make a level wood surface, but one that will remain level, and in the end save much of the paint material now used.

It is not enough that the wood-worker be able to understand a drawing, to imitate a pattern, or to cut closely, forming nice joints, or that he be able to produce a fine surface on a panel; but, to turn out a reliable job—one whose surface will remain as he has left it—he should also understand the nature of the wood of which his job is made. He should understand that a board, well adapted for a panel in a swelled sleigh, will not do at all for a large flat panel in a carriage-body, where swells or curves would be ruinous; but that different boards, cut from the same log and having the same care in seasoning, will frequently behave differently after being worked in a panel. The importance of properly getting out the pieces for each part of the body is understood by but few body-makers.

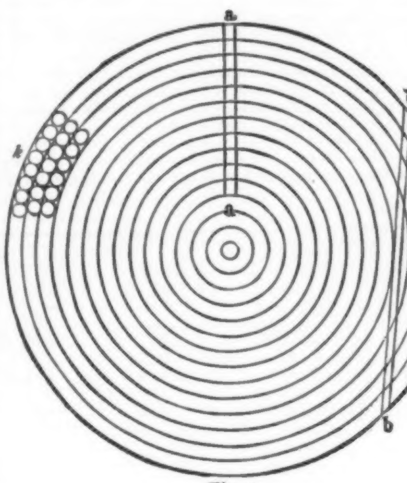


Fig. 3.

First, all kinds of wood have naturally the property of elasticity—but some more and some less. This elasticity, or property of expansion and contraction, exists mostly in the circumferential direction of the concentric rings or coats that are, by the yearly growth of the tree, laid over the surface of the preceding rings; see Fig. 3. Between these rings is found a woody substance much less dense than the grains or rings, and in ash and elm this spongy substance is found in a greater degree than in other woods used in carriage-making. The grain or ring of wood is by no means solid. It is formed of minute cells or elongated hollow sacks, running lengthwise in the tree. Fig. 3 shows the open ends of the cells as exposed by cutting the wood crosswise at *k*, and between the cells are seen angular open spaces, which extend through the entire length of the tree. These cells are so woven together as to form fibre. Some may think that this has nothing to do with painting, but we will see. During the life of the tree, these cells and angular open spaces are filled with a circulating fluid matter or sap, which, by the way, is never entirely dried out by seasoning, not even in charcoal. When the cells are filled with water, they expand; and just in proportion as the dampness is driven out by seasoning, they contract. Thus the elasticity of wood is manifested to a much greater extent by alternate changes of wet and dry, than by heat and cold. A simple experiment will satisfy any wood-worker that water or damp vapor never entirely leaves the cells of wood fiber even when kiln-dried, namely: Take a board that is thoroughly seasoned, say twelve inches wide and one inch thick, rip it apart so as to make of it two boards, each six inches wide. Plane these parts on all sides, joint the two new edges nicely, and then put the two boards together by screwing a batten across each end, being sure to get the same edges together that were united in the original board, and using no glue. Then keep them in a warm room, and in a few days it will be seen that the joint has become open by the shrinking of the wood. Now take them apart, plane them all over anew, and joint the edges over; put them together as before, and soon the joint will be open again. Repeat the operation any number of times, and it will be found that every time the boards are worked over, they will again shrink; for it is only a shell or outer crust that becomes dry. But after the boards have shrunken while thus battened together, and the joint opens no more, then put them together without planing them over, and the joint will remain close.

Fig. 4.

Again, take another board, the same size as before, and rip it apart so as to make two boards, each half an inch thick. It will make no difference how thoroughly the board may have been seasoned; the cells that were in the center of the original board will have retained a considerable amount of moisture, and now being exposed to the atmosphere, that side of the new board will shrink and become concaved. Again, plane any board level on one side, not planing the other side, and the newly-planed side will shrink and become concaved. Repeat the operation on the same board as many times as you please, and just as many times the newly-planed side will always shrink, and be found concaved. And again, if a board is planed on both sides, and more wood is taken from one side than the other, then the side from which most wood is taken off will become concaved, from the fact that the wood cells nearer the center of the board will have retained more moisture while in the dry-kiln than those nearer the surface on the opposite side, and, being exposed, they will consequently shrink more, and that side become concaved.

I would say, then, to the body-makers, that if a large flat panel is to be made of a board, it must be cut down thin. Then let most of the surplus wood be cut from the inner side of the panel, and as it shrinks it will become convexed on the outside; and when it has become thoroughly set or dry, with the leveling block and sandpaper it can be easily leveled. When you do this last leveling, be careful how you do it; remember Mr. H. F. Porter. But if the panel be put in with the damp side out, then the surface will sink down in the center, and in this case there is only one way to get the surface up level, and that is for the painter to lay on a large amount of paint material; see Fig. 4, wherein line *a a* shows the sunken surface of a panel that has been put in with the damp side out, and line *b b* shows the level surface that the painter is then compelled to make by laying on a large amount of roughstuff. Line *c c* shows the amount of heavy paint that must be cut off, after being laid on over the entire panel alike, in order to make the level surface at line *b b*. In this case, as in Figs. 1 and 2, there has been a waste of time, labor, and material, and all because the wood-worker cut most waste wood from the outside of the board of which he made the panel.

If such large panels, which should show a flat surface, be left slightly convexed, this slight swell will not mar the appearance of the carriage as would a concaved surface; for every one dislikes particularly to see a panel that has collapsed or sunk in the center.

When such panels have been properly set in and finished as nicely as possible, then set them away until they have dried out, and set a most careful hand to dress them over, being sure to leave them slightly convexed; for remember that in cutting away the outside shell, you will again expose new wood cells, and if the surface is not left a little full, it will sink below a level in the last shrinking.

It may perhaps be thought that this is spinning the thing rather fine, but if so, I ask the painter if he has any objections to raise to this kind of wood surface when he is required to paint carriages with less material, time, and labor? Is it calculating closer than Mr. Porter did when he counted the difference between two numbers of steel in the same spring, while calculating the required height of a carriage?

I have stated that all boards from the same log were not fit for large flat panels, and also that the contraction and expansion of wood existed mostly in the circumferential direction of the rings or grain. It follows that a board taken from the log at *a a*, Fig. 3, would shrink less in the direction that would warp or concave the panel than would a board cut from the log at *b b*. This fact deserves to be remembered.

Again, the experience of all wood-workers proves that if a swelled panel is to be made, a board next to the slab, as at *b b*, will warp easier, stand more strain, and endure more hardship while in a warped and strained condition, than will a board taken at *a a*.

In the case of a panel to be warped, as in swelled cutters, or other bodies of similar construction, if by the extra amount of elasticity, or expansion or contraction of this board, the swell should be increased or diminished, this slight change would not be noticed, as the panel is as easily painted, whether swelled much or little. A curved line admits of many changes, but a straight line admits of none. It should also be remembered that the contraction and expansion of wood is altogether lateral, or in a crosswise direction, while there is no perceptible change lengthwise of the stuff.

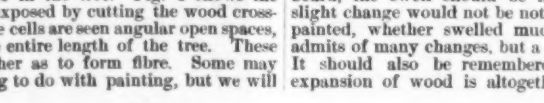


Fig. 5.

Thus, wood that is locky or much crossgrained should not be used for panels; see Fig. 5, wherein line *a a* shows the surface of a panel of crossgrained wood, and at *b* the end of the fiber is presented at the surface. Whether this sort of wood be worked in a straight or swelled panel, it will shrink after being planed, as will other wood. And as that shrinkage is across the fiber, or in direction indicated by the arrows, the end of the fiber at *b* not settling down, a prominence will appear at *b*, as illustrated in Fig. 2 at K, and then the painter must proceed as illustrated by Fig. 2.

Thus a permanent and reliable surface can only be made by using proper wood as a foundation for the paint, for although the surface of a crossgrained panel may be carefully worked before painting, yet a fine varnish will reveal the fact that at every change of atmosphere an irregular contraction and expansion is going on in the under surface of the wood.

The above will do at present for the wood-workers, and all will now see the truthfulness of the statement, that the condition of the wood-work is a most truthful precursor of what the final condition of the painting must be, and not only its condition, but its cost in material, time and labor.—*The Hub.*

To face oil stones, take a piece of even or straight-faced iron (if planed it is better); scatter a little emery or fine sand, about as coarse as No. 1½ sand paper, on the iron plate, add a little water and rub the face of the stone, renewing the emery, or sand and water, when necessary, finishing with water alone.

ANTIQUE ROMAN MARBLE VASE.

This magnificent vase was excavated in Italy at the beginning of this century, and soon afterwards purchased for some private collection in England.

We represent two views of this vase, in order to show in all its development the interlacing of the ornament in low relief, which covers the body of the vase, enriched by some figures in unsymmetrical but very graceful arrangement. To judge by the ornamental treatment, the work may be attributed to those Grecian artists who were called upon to contribute to the glorification of Imperial Roman luxury.

AN ART FAN EXHIBITION, LIVERPOOL.

AN exhibition of fans is at least a novelty in these utilitarian days, but our art brethren at Liverpool have actually formed a loan collection of this graceful appendage to the lady's toilet, and we understand there is soon to be one in London. A catalogue before us of an exhibition of fans at the Liverpool Art Club House describes a collection of over seems to have an object of great antiquity, especially among the people of tropical climates. Upon ancient Egyptian tombs painted representations of it are seen, and the bas-reliefs of the hall of the Rhamession contain the figures of twenty-three sons of Rhameses the Great, each holding a fan in the shape of a long ostrich plume fixed to a handle, and the title "Fan-bearer of the King" written over each. In Egyptian iconography the fan symbolized happiness. One of these ancient feather fans is described in the catalogue No. 1 as an "ancient Egyptian fan handle," the feather of which is missing. This form appears to have been the nucleus or ear.iest form of the fan. In Assyrian sculptures fans, composed of these palm leaves, are to be met with; and in India leaves of the palm, feathers, and reeds were employed. Various exhibits of Indian fans of these kinds are to be seen in the collection, and we may mention No. 5, sent by Mr. Fred. Holder, formed of fibre, radiating from a center disc, in the circumference of which is a loop-handle. This fan was used in dipping it into perfumed water before setting it in motion. The handle and disc are ornamented with floral patterns in colors and gold. Another Indian fan Audsley mentions that a million fans were ordered for the Philadelphia Exhibition. Paper leaves, decorated by block or hand-painted designs, are usually employed; the brins, or radiating pieces, and the panaches, or outside parts, being generally of bamboo. Mr. Audsley describes the folding and pressing of the leaf after it has been radially divided. We must not forget to note a series of war and ceremonial fans, contributed by M. Ph. Burty, of Paris, with metal panaches inlaid with silver. Passing various exquisite examples of Japanese and Chinese manufacture, some of tortoise-shell ivory, pierced or carved, filagree and enamel brins, with variously painted and perforated leaves, many of the latter composed of radiants of ivory, sandal-wood, or metal filagree, perforated in a fashion that contravenes the intention of air wafters, and some interesting specimens of English and French manufacture, Mr. Audsley tells us the fan became a fashionable article of costume in France during the reign of Henry VII., and in England during that of Henry VIII. Mr. Redgrave describes various fans of this and a later period, and artists of celebrity, like Paul Rubens, devoted themselves to fan-painting. The fans of the reigns of Louis XIV.

ANTIQUE ROMAN MARBLE VASE. DRAWN BY PROF. C. RIESS, STUTTGART.—*From The Workshop.*

200 fans, beginning with ancient Egyptian and Oriental to the latest French and English examples of this elegant article of attire. The list of contributors to this interesting and unique exhibition includes a number of names well known in art circles, and we find Mr. G. Ashdown Audsley and Mrs. Audsley, Mr. James L. Bowes, Mr. Julius Franks, Mr. Frederick Holder, Mr. J. A. Picton, Mr. and Mrs. Phené Spiers, large exhibitors. A succinctly-written historical sketch is given as an introduction from the pen of Mr. G. A. Audsley, which furnishes the reader with a general idea of the history of the fan. Its patent and expressive movements in the hands of the fair adept are well known, and we quite believe, with the French poet quoted, that the fan has played a no unimportant part in the art of coquetry. The different and expressive movements and flutterings of the fan is a language akin to that of flowers, and Mr. Mason mentions the well-known dexterity of Spanish ladies in what he terms "fan-flirtation" or "fan-telegraphy." A Spanish maiden with dark eyes is seldom ever depicted without the accompaniment of this magic sceptre, and that it has in every age become a powerful auxiliary in the hands of the belle few will doubt. Like other articles of dress, the fan is called the "tchaounry." Nos. 7 and 8 are examples. The former of these is formed of the tail of the yak, or ox of Thibet, mounted on a silver handle, and the latter is composed of delicate filaments of wood, mounted on a sandal-wood handle, elaborately carved. It is this kind of fan that is used over the heads of Indian princes to disperse insects. Various specimens of Japanese and Chinese fans are exhibited; some of these are fabricated in leaves, feathers, stout paper painted on one side, textile fabrics, etc. Mr. James L. Bowes exhibits several; one (9), of paper, has painted on one side a red orb on a gold ground, and on the other side a gold orb on a scarlet ground. The brins and penaches are of plain lacquered wood in this case, though in several they are of bamboo and pierced ivory. In China the fan is regarded as an attribute of rank, and the invitation to fan oneself is considered an act of politeness. It has been asserted that the folding fan is a Japanese invention, and was introduced into China by them; and, perhaps, no country has devoted so much artistic skill and taste to this article as Japan. It is certain those imported into this country are chiefly Japanese; and, in 1875, it is stated by Consul Annesley that three millions of fans were exported, and Mr. and XV. were exquisite examples of the most consummate art. Many of these have panaches and brins pierced, inlaid with pearl, decorated with jewels, relieved with color and gold. In works of the latter epoch the Liverpool collection is rich. No. 59, with a vellum-painted leaf with Arcadian subject, from a design by Watteau, the brins being of pearl, decorated in the Louis Quatorze style, may be noticed; also No. 60, of paper, beautifully painted in fine tempera—subject, betrothal of Louis XV. with Marie Leczinska, the work of Boucher. The brins, etc., are of white pearl, with carved medallions, and figures, and scrollwork in colored gold foils, and the fan belonged to the Queen of Louis XV.; exhibited by Julius Franks. Nos. 68 and 69 are of silk tissue, painted with classical subjects; No. 73 is a work of Boucher, with harmonious coloring—all lent by Dr. Piogey. No. 79 is another finely-painted fan, by Boucher, lent by Mr. Julius Franks. 75, on the painted vellum, with allegorical design, and refined coloring, and spangled with colored metals—period, Louis XV.—is a rich specimen of art workmanship. We note other exquisite works of the Parisian artists. The paper fans of the 18th century are exceedingly suggestive, and, as Mr. Audsley says, they have been used as a vehicle

for carrying political events, caricatures of great personages, and other information. Artists in metal, ivory, and wood, jewelers and enamelers, are engaged in this manufacture, and our French neighbors still take the lead in fan manufacture. We must not omit to mention No. 147—a Chinese fan with paper leaf, and with 14 brins composed of ivory pierced and carved, silver filagree and enamel, scarlet ivory, tortoise-shells, white pearl, etc., placed alternately, exhibited by Mr. R. W. Edis, F.S.A.; and especially the fine series of fans of the period of the French Revolution, lent by M. A. de Lies ville, of Paris, variously representing the taking of the Bastille, the Fête of the Federation, portraits of Louis XVI. and Lafayette, Robespierre burning Atheism and Fanaticism, and unveiling Truth, and portraits of Le Pelletier and Murat.—*Building News.*

RED BLOOD-CORPUSCLES.

By W. H. HAMMOND.*

IN my last paper on the structure of the living blood-corpuscles of a young trout, I pointed out that a nucleus could be plainly seen with a power of a little more than 300 diameters. I have since then extended my observations to the structure of the same corpuscles in the blood of other vertebrates. My first observation was made on a very young duck, and in this bird I was able to see the blood as it flowed in a small vein or capillary just at one part of the web of the foot. I could see plainly with the same power as before that the red blood-corpuscles are circular, with a distinct nucleus, which could be plainly seen both when the corpuscles exposed their broad surfaces, and also when they were sideways. These corpuscles have no cylindrical ring, but are flat from the nucleus to the circumference. My next observations were made on a living minnow and roach; the corpuscles are just like those seen in the young trout with a nucleus, clearly seen with the same power as before. In the living stickleback I noticed that the corpuscles are smaller than those seen in the trout (as is shown in Professor Gulliver's Tables), but of the same shape, and the nucleus is as plainly visible. On another occasion I watched the circulation in some young tadpoles and newts. In the very young tadpole I noticed that the red corpuscles were covered with small round bodies looking like vesicles; the corpuscles were oval when their broad surfaces were exposed, and appeared lanceolate when seen sideways. The corpuscles seemed very elastic, and were easily squeezed out of and resumed their shape when turning a corner. In the small blood vessels in which the corpuscles flowed in single file, I had a good view of the "tailing out" of the corpuscles; but, with the same power as before, I could not make out any

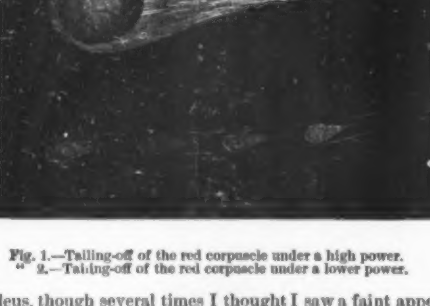


Fig. 1.—Tailing-off of the red corpuscle under a high power.
" 2.—Tailing-off of the red corpuscle under a lower power.

nucleus, though several times I thought I saw a faint appearance of it. In an older tadpole, which had two legs formed, I noticed that the corpuscles had fewer vesicles on them; in other respects they were the same as in the younger ones. In a frog's foot the corpuscles had no vesicles on them.

I then tried to see the circulation under a high power in the tadpole of the frog, in the newt, and in the frog's foot. I used a ⅛ objective with B, C, and D eye-pieces, and am happy to say that I was successful. I could with this high power see a nucleus in nearly all the red blood-corpuscles of the tadpole. The corpuscles are oval, and the nucleus is very large. When the corpuscles were sideways, I could plainly see the nucleus projecting on both sides; the nucleus does not project so boldly as in fishes, but is bigger and longer. This accounts for the lanceolate or fusiform appearance when seen under a lower power.

The tailing-off of the red corpuscle is due to the nucleus being displaced to the forward part of the envelope, as shown in the annexed engraving, and this fact is submitted as one of the proofs of the heterogeneity of the living corpuscle; in other words, that it is a compound body, and by no means simple and structureless.

In the young newt I could also plainly see the nucleus in the corpuscles. They are similar to the frog-tadpole's, but larger; the nucleus is very large, and the marginal portion very thin. I have several times seen this portion double back over the nucleus.

After the newt had been under the microscope some time, the circulation stopped in some of the small veins; the corpuscles then looked circular, were not so transparent, and showed no trace of a nucleus. I would ask, may not this have been the appearance which was seen by Professor Savory, and which led him to the conclusion that the red blood-corpuscles have no nucleus?

In the living blood-corpuscles the nucleus has a very different appearance to what it has when seen in the corpuscles after they have been drawn from the body and put on a glass slide.

In conclusion, I think I have now proved the existence of a nucleus in the living red blood-corpuscles of fishes, batrachians, and birds. I have been as careful as possible when making my observations under the high power; I sat a whole day watching the circulation in the tadpole of the frog and newt.

I must add that though the nucleus can be seen in fishes very plainly under a half-inch objective, with ordinary illumination yet in frogs, newts, and tadpoles, it requires a much higher power, and even then, unless the light is carefully regulated, the nucleus may be missed. I used a Webster condenser with the iris diaphragm, and found that as much care was required with the illumination as when resolving difficult diatoms.—*Microscopical Journal.*

AUGUST 2, 1877.

* It would be well if the author of this paper would refer to the splendid researches of Stricker, Schweigger-Seidel, Max Schultze, and Brucke, the last of whom describes the mammalian blood-globule as consisting of two separate parts, the *zooid* and *oekoid*. It may be remarked that Mr. Hammond's researches have this especial value, that they are confined to the *living* corpuscles of pyrenæmatous vertebrates.

FREE AMMONIA IN CAST STEEL.

By P. REGNARD.

ON breaking several ingots of steel made by "Ponsard's method," a decided odor of ammonia was noticed, accompanied by a slight hissing, the latter being very perceptible when the ear was applied against the ingot. The evolution of gas was clearly shown by wetting the fractured surface with soap and water, frothing resulted, and the volume of gas thus evolved from a single specimen was somewhat greater than one centimeter cube.

The gas was collected from one hundred ingots and analyzed. It burned with a scarcely luminous flame, and detonated strongly when mixed with air. It proved to be nearly pure hydrogen, with perhaps a trace of acetylene. No gas was obtained from the metal when it was re-cast previous to being broken.—*Compt. Rend.*

[The absence both of ammonia and nitrogen from the analyzed gas is so remarkable, that it might almost be supposed that the gas had been collected over water. It is not distinctly stated so in the paper, but it certainly seems to be implied that such was the case.—Abs.]—*Journal Chem. Society.*

PLATINUM ORE FROM THE URAL MOUNTAINS.

By SERGIUS KERN.

The platinum ores of the Nishni-Tanil and Goroblagodatsky districts contain notable quantities of foreign metals of the platinum group, with the exception of ruthenium, which occurs only in traces. The amount of platinum varies from 71·2—80·05 per cent., rhodium from 1·05—4·6, and iron, 3·4—13·4. The ore is not refined in Russia, but is sold at a low price to England and France, whence it returns as crucibles, etc., at a higher price. In Russia, French crucibles are preferred to English, but the author considers the platinum of the English crucible to be of a higher quality and purer, containing copper as traces, and iron to the amount of ·002 per cent., whereas the French crucibles contain copper (0·22—0·67 per cent.) and iron (0·3 per cent.).—*Chem. News.*

ACONITIC ACID IN THE JUICE OF THE SUGAR-CANE.

By ARNO BEHR.

IN the juice of the sugar-cane the author finds aconitic acid, $C_6H_6O_6$, which, he points out, may correspond, in the sugar-cane, with the citric acid $C_6H_8O_7$, that accompanies sugar $C_6H_{12}O_6$ in beet-root.—*Deut. Chem. Ges. Ber.*

DIFFERENCES OF CHEMICAL STRUCTURE AND OF DIGESTION AMONGST ANIMALS.

By F. HOPPE-SEYLER.

IN the glands of the stomach of every warm-blooded animal a ferment is found, named *pepsin*, which when extracted with water containing 0·2 per cent. of hydrochloric acid, gives a solution, capable, at the temperature of the blood, of rapidly dissolving albumen.

A somewhat similar ferment, discovered by Fick and Murisier in the stomachs of frogs, pikes and trout, differs from pepsin by acting most actively at a low temperature, as at 20°, and losing its digestive power at the temperature of the blood. This difference in the action of the two ferments probably resembles that between the diastase of the pancreas and of germinating barley.

In carnivorous plants, the acid reaction of the secretions, and the formation of peptone, coupled with the results of Gorup-Besanez's investigations on *Nepenthes*, suggested that the digestive property of these secretions is due to a ferment similar to pepsin. But experiments made in conjunction with Dr. E. Herter on *Drosera rotundifolia* have shown that it is neither pepsin, nor identical with the ferment contained in the stomachs of cold-blooded vertebrata.

It would be well to find out whether the so-called "spittle" of *Doleum galea*, which, according to Boedeker and others, contains free sulphuric and hydrochloric acids, also contains a ferment and is used for digestion.

Having sought in vain to find any statements as to the digestive ferments of invertebrata, I examined the river cray-fish.

In the stomach is found a plentiful supply of a yellowish-brown, feebly acid juice, which possesses an energetic fermenting power, and rapidly dissolves fibrin. The addition of a few drops of a ·2 per cent. hydrochloric acid solution stops the action, and other experiments show the ferment to be similar to, if not identical with, the albumen-dissolving ferment of the pancreas of vertebrata. The aggregated tubular glands, commonly known as the liver, proved to be the source of this juice. These glands may therefore be looked upon as forming the pancreas.

In the river cray-fish a proper stomachic digestion, such as is peculiar to the vertebrata, is entirely wanting, and consequently they possess enormously large glands having the property of the pancreas.

Comparative anatomists have called these glands liver, without however having enquired whether they performed the function of that organ or not. In vertebrata their function is the formation of bile and glycogen. Though a small quantity of the latter was found, it might easily have resulted from the large amœboid cells present in the organ. The constituents of bile were, however, not present, and so far as I know, neither biliary coloring matter nor acids have ever been found in any invertebrate. On the other hand, no vertebrate is known which, possessing a liver, does not form bilirubin, biliverdin and biliary acids. Now the biliary coloring matter is due to the decomposition of the coloring matter of the blood; but, with few exceptions, hæmoglobin is not found in the invertebrata, and those which do possess it in their blood, lack red corpuscles, the hæmoglobin being merely dissolved in the plasma. A liver producing biliary acids and coloring matter may consequently be considered as characteristic of vertebrata, just as well as a closed circulatory system containing blood with red corpuscles.

It is strange that amphioxus should be classed among the vertebrata, simply from the relative position of the spinal chord and digestive cavity to the *chorda dorsalis*, while with the exception of the latter, it possesses nothing in common with the vertebrata. A sound system of classification should not only consider the morphology, but summarize the entire organization. Considered generally, the cephalopoda stand next to the vertebrata; amphioxus is lower in the scale.

Again, comparing the constituents of tissues of lower organisms with those of higher, one finds the appearance of mucin-forming tissue, soon chondrin-forming, and lastly, in the cephalopoda the appearance of glutin-forming tissue. The same order is found in the successive stages of development of the embryo, and this can scarcely be considered an accidental agreement.

Looking at the question broadly, we find that the chemical composition of the tissues and the chemical functions of the organs present undoubted relations to the stages of development, which show themselves in the zoological system, as well as in the early stages of development of each individual higher organism. These relations deserve further notice and investigation, and are qualified in many respects to prevent and correct errors in the classification of animals.

It is generally supposed that the study of development is a purely morphological science, but it also presents a large field for chemical research.—*Pflüger's Archiv. f. Physiologie.*

FORMATION OF GLYCOGEN IN THE BODIES OF ANIMALS.

By J. FORSTER.

SUGAR was injected into the veins of dogs which had been kept without food for several days, the animals were killed, and the glycogen in the liver was estimated. Comparable experiments, omitting the injection of sugar, were also performed. A notable increase in the amount of glycogen found followed the injection of sugar. The author regarded this increase as a product of the increased decomposition of albuminous bodies in the organism brought about by the sugar. Sugar was detected in considerable quantities in the blood of the animals experimented upon.—*N. Rep. Pharm.*

FORMATION AND SEPARATION OF PEPSIN.

By P. GRÜTZNER.

PEPSIN diminishes during digestion. The author contradicts Schiff's statement that certain substances, dextrin for example, are capable of causing an increase in the quantity of pepsin in the juices of the stomach. Schiff's method of determining pepsin in the stomach is declared to be untrustworthy. The author's researches upon the variations in the amount of pepsin under different physiological conditions, show that the amount of pepsin in the stomach does undergo variation; that the smaller cells of the stomach or pylorus (Hauptzellen) when large and clear, contain much pepsin; when small and turbid, little pepsin. The amount of pepsin increases from the moment that nourishment is administered (to dogs) until the expiration of 9 hours; it then decreases until the expiry of 20 hours, when it again very slowly increases till 40 hours are passed, after which it remains constant.

The administration of common salt causes a larger secretion of pepsin: the salt appears to act by decomposing compounds containing pepsin in the pylorus.—*Chem. Centr.*

THE PANCREATIC JUICE OF HERBIVORA.

By A. HENRY AND P. WALLHEIM.

IT appears probable that the pancreatic juice of the rabbit, unlike that of the dog, continues to flow during fasting, though to lesser extent than during digestion. The quantity secreted amounts to from 0·6—0·7 c.c. per hour, and gives, as the mean of 14 experiments, 1·76 per cent. of solid constituents. The pancreatic juice of the sheep contains from 2 to 3·5 per cent. of solid constituents.

Chemically and physically these secretions differ considerably from that of the dog. Unlike the latter, the juice of the rabbit does not solidify on warming, but flocculent masses separate out from it and rise to the surface. Where the secretion shows on boiling but a slight opalescence, it becomes quite cloudy if acidified before boiling; the precipitate, however, re-dissolves in excess of strong acid. The juice dropped into dilute acetic acid, liberates carbonic acid. Nitric acid produces a flocculent precipitate, turning yellow on warming. Alcohol precipitates an albuminate.

The secretion of the sheep acts as above, except that, on dropping it into dilute acetic acid, a precipitate is formed which immediately re-dissolves.

The juices operated upon are believed, and, so far as possible, proved, to be the normal secretions of the organ.—*Pflüger's Archiv. f. Physiologie.*

ON SULPHOCYANATES IN URINE.

By R. GSCHEIDLEN.

THE sulphates and phosphates having been removed from 100 c.c. of urine by baryta-water, the filtrate evaporated to a syrup, extracted with alcohol, and the residue left on evaporating this extract dissolved in water, a solution is obtained which after decolorization with charcoal strikes a deep red color with ferric chloride. This color is due to the presence of a sulphocyanate. The absence of such other substances as could produce it having first been proved, the presence of a sulphocyanate was fully verified.

Experiments were made on the reactions of this substance, and, unless there be another body present, the results which have been obtained show that the various reactions observed by Schönbein, Sertoli, Lobisch and Voit are due to the presence of this sulphocyanate. This statement must be modified if, as sometimes stated, hyposulphurous acid is to be found in urine.

The results of 14 experiments made by means of Oehl's volumetric method gave 0·0225 as the quantity of sulphocyanogen in 1000 parts of urine; this corresponds with 0·0314 of sodium sulphocyanate and 0·0376 of potassic sulphocyanate.

The question now arose whether it was due to the saliva or formed by some special organ. The saliva of a dog having been diverted from the mouth was collected separately, and the urine also collected during six days. The saliva contained sulphocyanates, the urine none. A similar experiment in which the urine was collected for nine days gave a like result.

The total quantity of sulphocyanates in the saliva, as estimated by Oehl, agrees with that found in the urine.

From these investigations it appears that a sulphocyanate is a normal constituent of the healthy urine of mammals.—*Pflüger's Archiv. f. Physiologie.*

RELATION OF PHOSPHORIC ACID TO NITROGEN IN URINE.

By W. ZULZER.

THE author finds that the amount of phosphoric acid emitted in urine does not. as is generally supposed, bear a constant proportion to the nitrogen. From his own and others' researches, it appears that in the case of dogs and cats fed on pure fish, the relation of nitrogen to phosphoric acid is, on the average, 100 : 10·4—12·8. With addition of fat to the diet, 100 : 9·2—11·9. When the animal is fed on flesh, after previous starvation, 100 : 6·6—9·6 ; with potatoes, the phosphoric acid is 22·5—29·7 per cent. of the nitrogen ; with bread, 21·6—29·7 per cent.; with potatoes and fat, 30·8—37·3 per cent.; with calves' brains, 21·7 per cent. After abstinence from food, the proportion of phosphoric acid decreases for 1 or 2 days, and then gradually rises for 6 to 11 days, again slightly decreases, as in the case of a diet of animal food. Shortly before death, the amount again increases. With man, the usual proportion is 17—20 per cent. In the forenoon the ratio is higher than in the afternoon or night. Children have a much greater proportion than older people. The greatest observed amount was 58·5 per cent., and the smallest, 8·7 per cent. In old age, the phosphoric acid increases slightly. After reference to the proportion in cases of disease, the author comes to the conclusion that the variation of proportion is related to the change of matter in the nerves, and that in general, the change of material of the flesh depends on the nervous activity.—*Chem. Centr.*

DECOMPOSITION OF CRYSTALLIZED POTASH-ALUM AT 100°.

By ALEX. NAUMANN.

THE author finds that crystallized potash-alum gradually undergoes dissociation when heated to 100° in sealed tubes. The fused substance first gives off water of crystallization, and deposits a solid compound (probably anhydrous alum), after which there is formed in the liquid a basic compound of alumina, potash, sulphuric acid, and water, corresponding with that formed in alum solutions heated to 100°, as formerly described by the author.

In one experiment 15 grams of freshly crystallized air-dried alum was sealed up in a glass tube and placed in boiling water, when the alum melted to a perfectly clear liquid. In three hours a distinct turbidity appeared, and in five hours the liquid became quite opaque from separation of an apparently amorphous solid, which at the end of four days had settled down, leaving the supernatant liquid clear. At the same time crystalline laminæ were formed on the sides of the tube.

The deposited solid (weighing 8·5 grams), when treated with cold water, left 6 per cent. of insoluble residue (basic compound). The soluble portion was found to contain sulphuric acid, alumina, and potash in the same proportions as crystallized alum, as was also the case with the liquid contents of the tube.—*Deut. Chem. Ges.*

PURE MANGANESE CHLORIDE FROM CHLORINE RESIDUES.

By A. PIZZI.

THE clear liquid is boiled with granulated zinc until the ferric chloride is reduced and the iron precipitated in the metallic state together with any nickel that may be present. The liquid is filtered, sodium acetate and some acetic acid added, and the zinc, lead, and copper precipitated by hydrogen sulphide. On adding ammonium sulphide to the filtrate the manganese and cobalt are thrown down as sulphides: this precipitate after being thoroughly washed is treated with hydrochloric acid, which dissolves the manganese and leaves the cobalt. The solution of pure manganese chloride thus obtained yields pure manganese carbonate, and from this the other salts of manganese may be prepared.—*Gazzetta Chimica Italiana.*

NITRIC ACID AND ITS SALTS.

By DR. ADOLPH GEYGER, OF Berlin.

EVEN at the commencement of the present century a part of the saltpetre consumed in the various countries of Europe came from India as so-called exotic saltpetre, and the rest of the supply was obtained as native saltpetre by the lixiviation of natural or artificial nitre beds.

The consumption of nitrates in the chemical arts and in the manufacture of gunpowder and of other blasting materials has increased to such an extent that the earlier sources became utterly insufficient. A new supply was laid open in the vast deposit of a mineral very rich in nitrate of soda, discovered more than fifty years ago in the district of Tampa, on the border between Chili and Peru. The extraction of this deposit is still on the increase and furnishes by far the largest part of the raw material for the nitrates now used in the arts.

According to the statements of Dr. G. Langbein, there were in the year 1871 in the Peruvian nitre districts eleven large refineries with a daily production of about 6,000 cwts. purified nitrate of soda. The nitriferous mineral, called *caliche*, is found in beds from 0·25 to 1·5 metre in thickness, which, however, rarely arise to the surface. The superincumbent rock, *costra*, is from ½ to 2 metres in thickness, and consists principally of a hard conglomerate of sand, felspar, phosphates, and other minerals. The composition of the caliche fluctuates; it contains 48 to 75 per cent nitrate of soda, 20 to 40 chloride of sodium, and varying quantities of sulphates of soda and lime, nitrate and iodate of potassa, chloride of magnesium, etc., as also insoluble earthy matters and organic substances (guano). It is first broken up in a disintegrator and placed in the dissolving pans. Some of the establishments use long four-sided cisterns, but the better arranged works use closed egg-shaped boilers provided with two movable covers, of which the upper serves for the introduction of the caliche, and the lower for the removal of the exhausted material. The mass rests upon a perforated false floor fixed at about one-fourth the height of the boiler, and consisting of four pieces movable on hinges. The boilers are filled up to the top with the broken raw material, and up to half height with mother-liquor, and are heated by the direct action of steam, which is admitted by four pipes reaching below the false bottom. In from one and a quarter to two and a half hours the liquid is sufficiently saturated with nitre and is let off into settling tanks; after some hours' rest the clear liquid flows into flat crystallizers fixed in an open place and exposed to the wind. Latterly a second settling tank has been interpolated, in which the liquid is allowed to remain for about half an hour, in order to deposit the common salt which is held in mechanical suspension before being run into the crystallizers.

The residue left in the boilers, which still contains from 15 to 35 per cent soda saltpetre, is either cleared out at once or extracted once more with spring water. The closed boilers are simply emptied by letting down the lower or true bottom, when the residue falls into wagons run in beneath, and is drawn away from the works. The crystals of nitre which form in the crystallizing pans after the mother-liquid is drained away are spread upon a large surface exposed to the wind, and called *cencha*, in layers of from 30 to 50 centimetres in thickness, and dried by being frequently turned over. The total cost of 1 cwt. of Chilian saltpetre up to its conveyance to Europe was calculated in the year 1871 by Langbein, as follows:

Cost of production	3·25 marks.
Conveyance to the coast	2·40 "
Cost of shipping	0·25 "
Freight to Europe	2·75 "
Charges on arrival	0·25 "
	8·90 "

or about 8s. 8d.

W. Lloyd, in 1868, calculated the cost of production at 8·40 marks per cwt. The rise of price in spite of the improvements in the process of purification is due to the enormous increase in the cost of labor and in the freight to the Port Iquique. Although the saltpetre districts have been now for some years connected with the port by a railway, the greatest part of the produce is still conveyed upon mules.

The exportation of nitre is still constantly on the increase, as the following figures prove:

1830	18,700 cwts.
1835	140,399 "
1840	227,362 "
1850	511,845 "
1860	1,370,248 "
1870	2,943,413 "
1871	3,605,906 "
1872	Upwards of 4 million cwts.

By the decree of July 12th, 1873, the Peruvian Government has taken the saltpetre trade into its own hands, and has fixed the quantity that may be yearly exported at 4½ million cwts. As to the effect of this monopoly upon the saltpetre trade, no decision can as yet be formed.

As a specimen of the composition of the purified soda saltpetre, as imported into Europe, the following very complete analysis, published by Wagner, may be cited:

Sodium nitrate	94·03
" nitrite	0·31
" chloride	1·52
" sulphate	0·92
" iodate	0·29
Potassium chloride	0·64
Magnesium chloride	0·93
Boracic acid	trace
Moisture	1·36
	100·00

The mother-liquor of the refineries contains from 2½ to 5 grms. iodine per litre, and is used in some Peruvian establishments as a source of that body.

As to the origin of these saltpetre beds in Peru, various explorers have published their opinions, but without giving a fully satisfactory explanation. Indeed it would almost seem as if the formation had taken place under circumstances which have remained hitherto unknown. According to H. Reck, Chili saltpetre is the oxidation product of large guano beds whereby, however, as Nöllner very justly remarks, it remains unexplained what can have come of the great mass of sparingly soluble phosphate of lime, while the readily soluble nitrate of soda remains behind.

CHEMICAL REAGENTS.

By MALVERN W. ILES.

ALTHOUGH it is generally conceded by chemists that reagents should be pure, yet too often, I am convinced, is this subject disregarded even by competent analysts.

Many discrepancies can, I think, be traced to this source, for if the very tools which the chemist uses to make the elements respond to his inquiries are defective, then his responses must inevitably be more or less erroneous.

It has been a subject of note with what extreme care the analyst determines the ash of filter papers, even to a very small fraction of a milligramme, yet entirely disregards the fact that his reagents may be contaminated with phosphoric and sulphuric acids, also soda, potash, etc.

In the analysis of an iron ore in which a determination of phosphorus and sulphur is required, it is of the most vital importance that the chemical reagents used should be absolutely free from sulphuric acids.

Prof. Albert Leeds read a paper before the New York Academy of Sciences, in which he mentions the wide distribution of phosphoric acid in nature, having found it in a number of substances in which it was little expected.

The scientific metallurgists have of late years greatly improved the quality of their iron and steel, by securing flux, fuel and building material, containing a minimum of sulphur and phosphorus. Should not the chemist who lays claim to accuracy be equally careful in respect to his results? To illustrate this point, W. H. Greenwood states that "sulphur and phosphorus are the great enemies of good steel; 0·2 per cent. of sulphur renders the metal brittle and red short, while 0·1 per cent. of phosphorus is objectionable, as tending to render it *cold short* and unworkable at ordinary temperatures." We can easily see what great mischief would be caused by an incorrect analysis under such circumstances.

Fresenius states that we should make it an invariable rule to test the purity of our reagents before we use them, no matter whether they be articles of our own preparation or from other makers.

If this excellent advice were placed in the form of a question to many an analyst, I imagine it would be a source of embarrassment. Nor could a satisfactory excuse be given by stating that all their chemicals were labeled *chemically pure* (C. P.)

I have frequently found chemicals upon which the letters C. P. occupied a most conspicuous place, which upon qualitative analysis showed large percentages of impurities. I therefore look with suspicion upon every chemical labeled *chemically pure*, and regard it generally as a trick of the manufacturers to obtain a higher price for their goods than they really deserve.

In order that I may not be mistaken, I will state, I believe there are conscientious manufacturing chemists who greatly promote chemical science by the care and intelligent labor they give to their chemicals.

It is not my intention to give a systematic treatise upon chemical reagents ; but simply a brief statement of the impurities detected in reagents used in the Qualitative Laboratory of the School of Mines, which it is thought will be a fair representative of chemicals used in laboratories ; since the reagents examined are both from American and foreign manufacturers.

The enumeration of the impurities detected will, it is hoped, be of more or less interest to the manufacturing chemist, the analyst, and the pharmacist.

IMPURITIES DETECTED.

Ammonium Hydrate.—From C. K. Kraft, marked C. P., is quite pure; it however contains a trace of alumina and some carbonic acid, probably from the atmosphere.

Ammonium Acetate and Carbonate were found to contain traces of chlorine.

Ammonium Chloride.—From E. Merck, Darmstadt (labeled C. P.)—I found a large quantity of dirt, chips, etc. A trace of sulphuric acid was also detected. By filtration a fair article is obtained.

Ammonia Iron Alum (bought for C. P.) contains a trace of manganese, lime and an appreciable amount of chloride.

Ammonium Sulphate (from E. Merck) contains a very large amount of chlorine, a trace of nitric acid, and considerable soda.

Arsenic Salts are very liable to contain both the *ous* and the *ic* acids.

Barium Carbonate.—I examined a number of samples of this salt, and found it remarkably impure. Since in the Qualitative Laboratory it is constantly used, grave errors might easily arise from its use. I find, besides *some* barium carbonate, the following impurities: Phosphoric, hydrochloric and silicic acids ; alumina, lime, magnesia (trace), manganese (trace), large amount of soda, and a very large amount of barium sulphate.

Barium Chloride.—The sediment from this salt was found to contain potash, lime, alumina, carbonic, silicic and sulphuric acids; considerable organic matter was detected. Even with the above mentioned impurities, the salt is sufficiently pure for qualitative purposes, since it is almost exclusively used for the detection of sulphuric acid.

Barium Nitrate.—E. Merck's article contains an appreciable quantity of barium sulphate. Charles T. White's barium nitrate contains no barium sulphate; the salt was found to be very pure.

Calcium Chloride contains some carbonic and sulphuric acids, also a small amount of calcium hydrate.

Chrome Alum contains a little iron and alumina ; also silicic acid.

Hydrochloric Acid (from C. K. Kraft, labeled C. P.)—Generally contains a minute trace of iron and arsenic.

Hydro-di-sodic Phosphate contains quite an appreciable amount of sulphuric, a trace of hydrochloric, and also silicic acid, and some alumina. (From E. Merck, labeled C. P.)

Magnesium Sulyhate contains a trace of nitric acid. (From E. Merck, bought for C. P.)

Nitric Acid (from C. K. Kraft, C. P.), sometimes contains a trace of iron, otherwise very pure.

Lead Acetate contains some iron, hydrochloric and sulphuric acids.

Minium contains zinc.

Potassium Antimonate (from E. Merck), contains a a very large quantity of potassium carbonate.

Potassium Oxalate contains a very large quantity of sulphuric acid. (From E. Merck, bought for C. P.)

Potassium Hydrate (commercial), comes in a liquid form from C. K. Kraft; the sediment contains considerable alumina, a trace of manganese, iron, lime, silicic, carbonic and hydrochloric acids. (Commercial article, not labeled C.P.)

Stick Potassa, from Powers & Weightman, contains a remarkably large quantity of potassium chloride, considerable alumina, and of course, some carbonic acid, which it absorbs from the air. E. Merck's stick potassa is quite pure; it contains, however, a trace of alumina.

Potassium Sulphate contains alumina, sulphuric acid and organic matter.

Sodium Acetate contains a trace of chlorine.

Sodium Carbonate.—E. Merck's dry anhydrous sodium carbonate is generally very pure ; it, however, frequently contains a minute trace of sulphuric and hydrochloric acids. Some samples are entirely free from sulphur.

Sulphuric Acid (common) comes from C. K. Kraft, contains iron and lead, very rarely contains nitric acid or oxides of nitrogen.

Sheet Zinc contains considerable lead. Granulated Belgian zinc contains a trace of iron. New Jersey and Lehigh zinc is nearly chemically pure, contains only a trace of iron, and occasionally arsenic in minute quantities.

SEPARATION OF SAL-AMMONIAC IN URINE.

By C. VOIT.

A KNOWN quantity of sal-ammoniac was administered to a dog which had fasted for some days. The amount of urea found in the urine increased considerably; nevertheless experiment showed that the greater part of the ammonia originally administered as sal-ammoniac passed through the body unchanged. The increase in secretion of urea cannot therefore be traced to the synthesis of that compound from the sal-ammoniac administered. The author is disposed to regard the action of sal-ammoniac as comparable with that of sodium chloride, viz., as promoting decomposition of albuminoid substances in the organism.—*N. Rep. Pharm.*

MODIFICATIONS OF ANIMAL FATS.

By H. C. BARTLETT.

THE analysis of a large number of pancreatic glands, taken from pigs, dogs, calves, and other animals, showed that the fatty components of most of the glands contained considerable proportion of volatile fatty acids combined with glycerin. These are, perhaps, not true synthetical reproductions of the glycerides, but compounds of soluble

fatty acids and glycerin, resulting from the decomposition of the natural saponification-product during digestion; they are almost identical with the similar compounds separated from butter by the means now in use for analyzing butter. In order to estimate the proportion of volatile oil in the fat extracted from these glands, the author uses potash and alcohol for saponification, and decomposes with dilute acid (sulphuric or hydrochloric). This being accomplished in a retort, the condenser is luted tight, and the aqueous liquid distilled over until an exact fourth is left, to which fresh water is added, and the distillation continued as long as the water condensed gives any acid reaction. Baryta-water is added to the distillate, and the whole redistilled down to about 5 per cent of its original bulk, after which it is evaporated to dryness in a vacuum at 45°. The barium salts thus obtained are in triplicate, one series being soluble, the intermediate salts l ss so, and the third somewhat difficult of solution. Since the author has not yet succeeded in separating these salts, each in sufficient purity from the others, he cannot speak with certainty as to their exact identity with the caprates, butyrates, caprylates, and caproates of butter; but he can confirm the presence of caproic acid, caprates, and caprylates by the crystalline form and other appearances of these salts. It is further stated that a considerable quantity of volatile and soluble fatty matter may be found during the digestion of fat in the intestine, and particularly at the time of absorption. From this the author was induced to conclude that the transformation of a portion of neutral fats into fatty acids and glycerin by the pancreatic and other digestive fluids is the result of fermentation.—*Analyst.*

THE POISON OF THE COBRA DE CAPELLO.

By A. W. BLYTH.

THE poison, which may be obtained by pressing the parotid glands, while the fangs are erected, over a watch-glass, is an amber-colored, syrupy, frothy liquid, of sp. gr. 1·046, and of feeble acid reaction, drying rapidly on exposure to air, leaving a yellow, acid, pungent powder, to the amount of about 33 per cent. The poison contains albumen, a minute quantity of fat, and 1·4—1·5 per cent of ash, mainly consisting of sodium chloride, is obtained on incineration; it is not decomposed at 100°, and the uncoagulated portion preserves its activity for a long time. On heating the yellow powder to 270°, it blackens, and above 270° a sublimate is formed. A similar substance, crystallizing in needles, may be obtained by dialyzing the poison. It exists in the venom to the amount of 10 per cent, and is highly poisonous, appearing to be the only active principle. It is obtained pure by means of the lead-salt, and evaporation in a vacuum. For want of material no analyses have been made, but the name of *cobric acid* is proposed for it. A dilute solution of potash, or a weak alkaline solution of potassium permanganate, destroys the poisonous properties of the cobra poison.—*Analyst.*

THE FUNCTION OF CHLOROPHYLL.

By R. SACHSSE.

SINCE Bäyer has discovered that furfurol, when mixed with resorcin or pyrogallol, gives with a trace of hydrochloric acid a beautiful indigo-blue substance, and surmised its identity, or at least analogy, with chlorophyll, the author has repeated Bäyer's experiments, with the following results: Pyrogallol is dissolved in alcohol; hydrochloric acid and ferric chloride are added, and finally some furfurol. The fluid slowly turns green, and keeps its color for a long time, finally, however, turning brown, with a tinge of violet. The absorption-spectrum of this color shows a tolerably well-defined band in the red, while blue and violet are almost wholly absorbed, the band being nearly coincident with the line I of chlorophyll. It has been supposed that the function of chlorophyll in plants was to absorb light and convert it into vital force. But the unabsorbed light, viz., yellow, is most energetic in decomposing carbonic anhydride; besides, chlorophyll is continually being formed and destroyed. Several theories have been advanced on this subject. Wiesner supposes chlorophyll to be the active agent in reducing carbonic anhydride, and attempted to reduce that substance by passing a current through a solution of chlorophyll in alcohol.

Kraus supposes a body, which he calls leucophyll, to combine with aldehydes, which are reduction-products of carbonic acid. This compound is continually destroyed, and leucophyll again formed, when the reaction again takes place. Timiriaseff's hypothesis is that a substance, called by him *chlorophyllin*, is changed by light into a brownish-yellow body, *phylloxanthin*, oxygen being evolved, and replaced by carbonic oxide formed by reduction of carbonic anhydride, and the color being restored. The author of this paper believes that chlorophyll is the first product of the reduction of carbonic anhydride and water, and is itself converted by further change and reduction into starch and carbohydrates. This accounts for the circumstance that, when starch is in course of formation, the amount of chlorophyll diminishes. Wiesner also draws attention to the fact that, in young *orabanchaceæ*, starch is converted into chlorophyll as the plant grows older. Hoppe has recently shown that pyrocatechin is a derivative of carbohydrates, and furfurol has long been known to be connected with them.

The author's views stand in opposition to Wiesner's experiments, which tend to show that chlorophyll in alcohol solution is destroyed by light and oxygen, but he maintains that this may not express the reaction which occurs in the living plant, for almost all colors may be destroyed by bleaching, and the color of chlorophyll is also destroyed by reduction. The synthetical aim is, therefore, to convert chlorophyll into carbohydrates. Should this be accomplished, we shall be better able to understand the formation of these substances from their elements.—*Chem. Centr.*

HEAT IN THE SILVER MINES.

THOSE who have never personally inspected the lower levels of our mines may obtain some idea of the degree of heat to be found therein by visiting the Savage works at the change of shifts The men—packed together as close as they can stand on the cage—are popped up out of the shaft all steaming hot, for all the world like a bunch of asparagus just lifted from the pot. They make their appearance in a cloud of steam that pours up continually from the "depths profound," and are dimly seen until they step forth upon the floor of the works. As the men land and separate, each carries with him for half a minute his little private cloud of vapor. As this passes off the man is seen to be naked from the waist up, his skin as wet as though he had just been lifted out of a pool of water. The men bring up with them—besides the steam—an amount of heat that may be felt by the spectator as they pass.

All this is at the top of the shaft, where it is considered quite cool—what, then, must it be hundreds of feet below, where the men started from—down where the water stands at 157° Fahr.? Down there no steam is seen—it is too hot for it. It is only when the hot, moist air coming up from the lower regions strikes the cool air towards the top of the shaft that it takes the form of steam. Down where the men come from you must keep your hands off the pump column and the pipes, and if you pick up any iron tool you will at once put it down without being told to do so. Down there they handle things with gloves on, or wrap rags about the drills they are guiding and iron apparatus they are moving, and down there, too, you will learn to keep your mouth shut after you have drawn a few mouthfuls of hot air into your lungs.

Perspire? It is no name for it. You are like a sponge that is being squeezed. You are ready to believe that you have ten million pores to every square inch of surface, or as many more as any authority may mention, and that all these pores are as big as the cells of a honey-comb. You go for ice water, and it almost seems to hiss as it passes down your throat—you keep going for it, and thus, in a short time, find out what becomes of the tons and tons of ice that are daily consumed in the mines. Remain below among the miners for an hour or two, and when you are finally popped out at the top of the shaft, all red hot and steaming, among the other asparagus sprouts, you will appreciate the beauty, the light, and the coolness of the upper world.—*Virginia Enterprise.*

BUBBLES BY HEAT.

By WALTER NOEL HARTLEY.

THE paper deals with the bubbles in fluid cavities of crystals, and their behavior when a source of heat is brought near them. A long course of experiments has revealed the following facts:

1st. That the bubbles in fluid cavities of minerals are sometimes attracted by a source of heat.

2d. That bubbles are sometimes repelled by the same source of heat.

3d. That a rise of 5° or 6° C. above the temperature of the specimen suffices to cause attraction.

4th. That a rise of only ½° C. will in certain cases cause repulsion.

5th. That in certain cases the same bubble was repelled under ordinary conditions, but when its temperature was raised to 60° it was attracted, the source of heat being from ½° C. to 5° warmer than the specimen.

6th. That this could oocur in cavities containing liquid carbonic acid as well as water, but that it made no difference whether the carbonic acid was raised above the critical point or not. This affords a means of controlling to some extent the conditions of the experiments, since carbonic acid at a temperature just above its critical point has a tension of 100 atmospheres.

The author shows reasons for not being satisfied with Prof. Tait and Swan's explanations of the movement of bubbles in Iceland spar, noticed by Mr. Lang, of Edinburgh. He stated that the warmth of the fingers is sufficient to propel even in a vertical direction a plug of water contained in a capillary tube open at both ends, and he refers the attraction of bubbles by heat to the same cause which occasions this movement. In communications addressed to Mr. Hartley, Prof. Stokes states that this *repulsion* of the liquid is due to the diminution by heat of the surface tension at one end of the plug of liquid in a tube or side of a bubble in a cavity.

When repulsion of a bubble, or *attraction* of the *liquid*, takes place, it is because a slight rise in temperature effects a disengagement of gas from the water on the side of the bubble nearest to the source of heat, which increases the surface tension at this side: the bubble is therefore propelled in the opposite direction. Considering that these explanations may meet every fact which he has noticed, the author has abandoned his own theory with regard to this movement. Those who have given great attention to the study of fluid cavities in minerals are acquainted with the occurrence in some granites, and other quartzose rocks, of minute vibrating bubbles. Sometimes they have been seen floating on liquid carbonic acid, but under such conditions they are very rarely met with. They vary in size from $\frac{1}{30000}$ to $\frac{1}{15000}$ of an inch in diameter, the more minute bubbles having the most rapid motion. They always move over to the warmer side of the cavities in which they are contained, and any appreciable rise of temperature causes them to cling to that side for a considerable time, quite motionless. Since all substances are continually gaining and losing heat, it is impossible to imagine a body which, throughout its entire mass, and at the same instant of time, is one of uniform temperature. It is evident, then, that an easy movable particle of very minute size, which can be set in motion by exceeding slight rises of temperature, may make the transformation of heat from one point to another plainly visible; hence these vibratory motions are considered to afford an ocular demonstration of the continual passage of heat through solid substances.—*Proc. Roy. Soc.*

THEORY OF COLORS APPLIED TO THE ARTS AND TO INDUSTRY.

This is a notice given in the *Moniteur Scientifique*, of a work by Prof. Bezold of the Polytechnic School of Munich, an English edition of which has been brought out in America. The author objects to Chevreul's arrangement of colors, and maintains that the principle of the chromatic color does not agree with the laws of the mixture of colors. "In fact the admixture of black is equivalent to a decrease of intensity, for the abated colors obtained by this mixture may also be obtained by illuminating more and more feebly a surface painted with a pure color. We know that when the day declines all colors darken and become converted into black. But, on the other hand, an admixture of white is not equivalent to an augmentation of intensity, for the whitened colors are not pure colors intensified; they are colors imperfectly saturated. M. Chevreul confounds under the name of 'ton' two modifications essentially distinct The chromatic circle also does not contain the gamut of white, *i. e.*, the series of grey shades which represent the mixtures of white and black, nor do we find in it the mixture of the colors with white and black at once. An attempt has been made to correct this imperfection of the chromatic circle by adding nine chromatic circles uniformly lowered with black, but in this manner many colors are necessarily repeated several times in the successive circles." M. Bezold proposes to revert to the "chromatic cone" of Lambert, the construction of which agrees with the principles established by Helmholtz and Maxwell. On these principles every sensation of color depends on the factors by which it is completely determined; for these we may take: 1. A pure color defined by its wave length (Chevreul's *nuance* and Helmholtz's *ton*). 2. The luminous intensity of this color, which may be determined by the quantity of black to be added to the normal shade. 3. The degree of saturation or of purity, which depends on the quantity of white to be mixed with the normal color. To obtain all the colors possible it is needful to form a chromatic circle with a certain number of distinct colors distributed on the extreme circumference, and degraded successively by admixture with growing proportions of white, to the center which is occupied by white. We then form a similar series of circles by successively diminishing the luminous intensity of the colors contained in the first by an admixture of black. For the colors to be placed on the circumference of the circle M. Bezold takes in the outset the following ten, which form five pairs of complementary colors: Red and green-blue; orange and blue; yellow and ultramarine; yellow-green and violet; green and purple. The wave-lengths of the two complementary colors are to each other about 4 to 5; but we remark that the purple, a compound color not existing in the spectrum, is not defined by its wave-length. M. Bezold admits that the difference between the yellow-green, the green, and the blue-green is much less sensible than that which exists between their complementary colors, violet and purple, or purple and red. He therefore subdivides the violet into blue-violet and purple-violet, and the red into carmine and scarlet, thus obtaining a scale of twelve equidistant colors.

ELECTROSILICIC LIGHT.

By G. PLANTE.

WHEN a platinum wire crosses a capillary tube filled with a saline solution, and a current of electricity caused by 60 to 250 to 300 secondary couples (depending on the nature of the salt) is passed through the wire, the glass fuses, even in contact with the liquid, and emits a dazzling light. When the knob of platinum has become coated with a glass, it is isolated from the liquid, and the light disappears. With a solution of salt, 250 to 300 secondary pairs are necessary: with nitre, 60 pairs equal to 90 Bunsen's cells. The intensity of this light depends on the nature of the silicate (glass), which is devitrified by the heat, while a light vapor with slight alkaline reaction is evolved. The spectrum of the light is not that of the lime combined with the silica; a fragment of calc-spar under the same circumstances gave a calcium spectrum. The rays of silicon are so weak as not to be visible through the very bright continuous spectrum, in the same way as the spectrum of carbon is not visible in the incandescent voltaic arc.

But that silicon is the cause of the light is shown by its formation with crystals of pure silica, and it probably arises from the incandescence of *silicon* liberated from the silica by the intense heat.—*Compt. Rend.*

CARBON POINTS FOR THE ELECTRIC LIGHT.

By F. CARRE.

ATTEMPTS were made to impregnate the carbon terminals with various salts, in order to modify the light. The following results were obtained:

1. Potash and soda double the length of the electric arc, and render it silent; they combine with the silica contained in the carbon, and the silicate is deposited in the form of vitreous globules at 6 or 7 mm. from the points. These substances increase the light in the ratio 1·25 : 1.

2. Lime, magnesia and strontia increase the light in the ratio 1·3—1·5 : 1, with production of various colors.

3. Iron and antimony cause an augmentation of light in the ratio 1·6—1·7 : 1.

4. Boric acid increases the hardness of the carbon points, but does not increase the light.

The manufacture of carbon points by impregnating pure and homogeneous charcoal with solutions of the above substances is convenient and economical, but it is better to mix the substances with the charcoal in powder.

In the latter case the carbon is purified by washing, etc.; it is then mixed with the salt, moistened with a solution of gum, and pressed through a wire-drawing machine by means of a powerful hydraulic press.

The carbon terminals thus made are very superior to those obtained from gas carbon; they are very tenacious and rigid, and being perfectly homogeneous, the light obtained by their means is much less liable to variation; further, they do not explode when ignited, as there is no enclosed gas.

AN ANCIENT SPECIMEN OF TIN.

By. PROF. A. H CHURCH.

TOWARDS the close of the year 1875 a mummy, which had been recently brought from Egypt by Lord Eustace Cecil, was unrolled under the superintendence of Mr. R. H. Soden-Smith, of the South Kensington Museum. Beyond a strip of white metal nothing was found within the cloths of the embalmed body. This strip of metal was embedded in pitch resting on the breast in contact with the flesh—the usual position of the scarabæus emblem. It was destitute of all ornament or engraving, but presented the outline of the winged scarabæus, in the form of which it would have been fashioned had the mummy been of the first class, such a scarabæus being an emblem of immortality among the Egyptians. The date of this mummy must be placed not later than 600 or 700 B. C. It became of interest to ascertain the nature of the metal of which the small plate was composed. On making a qualitative testing of a small fragment it proved to be pure tin, neither lead nor silver being detected. As sufficient material for a complete analysis could not be appropriated, an exact determination of the specific gravity of the specimen was made. The figure thus obtained was 7·369 at 16° C., a number very near that of pure tin, namely, 7·29 to 7·373.

In the British Museum, the Louvre, and the Egyptian Museum at Turin, there are several small oblong and square plates of metal which have been likewise found in unrolling Egyptian mummies. Where labeled they are generally described as "silver," "lead," "white metal," or "mixed metal," and in most cases appear to contain, if not to consist of, lead. That the ancient Egyptians were familiar with some of the uses of tin—as in enamels and bronzes—has long been known; that they were acquainted with tin in a state of chemical purity would now seem to be established.

The strip of tin weighed 4·031 grms., and was about 0·3 millimetre thick, 93 m.m. in length, and 18 m.m. in breadth.—*Chemical News.*

[FRANKLIN JOURNAL.]

THE ELECTRIC REGISTER AND KOENIG'S TUNING FORKS.

By LEE. C. COOLEY, Ph. D.

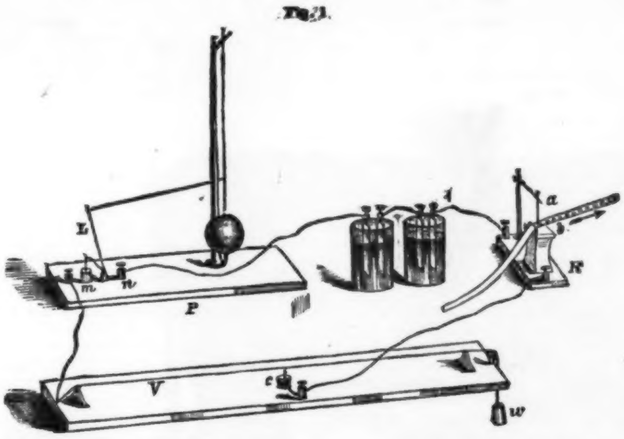
THE application of electricity to register rapid vibrations was first made in 1868.* In that year I succeeded in obtaining a direct registry of the vibrations for all the intervals of of three successive octaves on a piano.† The wire was made to open and close a battery circuit in which an electro-magnet was placed, whose armature carried a stile, and, responding to the alternate efforts of the electric pulses and an opposing spring, flew back and forth in unison with the vibrating wire, and left a dot for each vibration on a strip of moving paper.

But the motions of an armature are too sluggish to keep pace with vibrations beyond a certain degree of rapidity; hence, the electro-magnetic method was speedily abandoned, and an electro-chemical registry substituted. "The requirements are: first, a steady stream of electricity from a powerful battery; second, means by which the vibrating body may open and close this electric circuit; and third, a rapid motion of chemically-prepared paper, through which the electricity is passing."‡

In the instrument first constructed, a fine copper wire, forming one electrode of the battery, was rapidly drawn along over the surface of a strip of tin-foil forming the other. A strip of tissue paper moistened with acidulated water, lay upon the tin-foil; upon it the moving wire constantly pressed, and every electric pulse traversing the paper left a velvety black stain upon the foil beneath. The vibrations in any measured period of time were thus revealed in a series of dots easily counted and permanent in the highest degree; records made then are as distinct to-day.

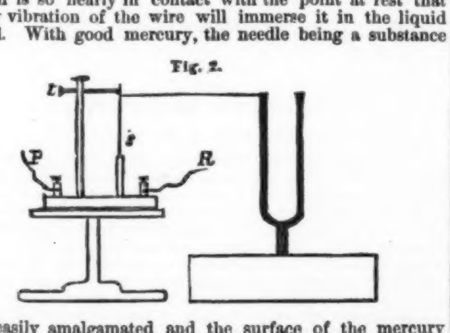
With this instrument the laws of vibration were demonstrated by an almost unerring registry in several courses of lectures, yet certain difficulties in manipulation forbade the expectation that it would become generally useful. By changing the form of the apparatus and perfecting the method, however, the electro-chemical registry became, it seems to me, a matter of comparative ease, enabling one to study phenomena depending on rapidity of vibration, with the precision attained by actual count. Whenever the vibration is of amplitude sufficient to open and close an electric circuit, an *autograph* of vibrating body will be the given in dots to be counted at leisure, and representing its rate within very narrow limits of error.

Fig. 1.



The accompanying cut represents the apparatus, arranged for the study of vibrating wires. The wire, *V*, a time measurer, *P*, and the register, *R*, are included in the same battery circuit. The wire is enabled to open and close the circuit by means of a fine steel needle, fixed to its middle point, beneath which is a cup of mercury, *c*, the surface of which is so nearly in contact with the point at rest that every vibration of the wire will immerse it in the liquid metal. With good mercury, the needle being a substance not easily amalgamated and the surface of the mercury covered with alcohol to prevent oxidation, when once adjusted, little attention is needed afterward. Clean mercury may be substituted from time to time, and the needle may, if necessary, be cleaned by nitric acid.

Fig. 2.



For the measurement of time a pendulum is employed, which holds the circuit during the time of one beat. The arrangement for this purpose is represented at *P*. A slender fibre is fastened to the pendulum-rod, and thence reaches over to the upper end of a light bent lever, *L*. This lever moves freely, and is in conducting communication with a binding post, *n*. Beneath the lower end of the lever is a mercury cup, *m*, in metallic connection with another binding post. When the heavy pendulum is at rest, the weight of the lever keeps the fibre tense, and the mercury surface is so adjusted as to be exactly in contact with the point of the lever, a most vital adjustment, but one very easily made. It will be seen that the pendulum, when vibrating, must compel the lower end of the lever to be alternately in and out of the mercury during the exact time of one vibration.

The record of the vibrating wire is made in the register, *R*. A metallic point, *a*, presses upon a strip of chemically, prepared paper, which runs over a platinum surface *b*. The pen and the platinum beneath are each provided with a binding post, by which it can be made a part of the circuit. The paper may be drawn through by the hand of the operator, the more swiftly as the vibrations are more rapid.

Let the circuit be continuously closed while the paper is in motion, and a continuous colored line will be traced by the pen, *a*; but let the wire vibrate, and electric pulses in unison with it will traverse the paper, leaving a series of dots instead. If the pendulum be at the same time in motion, the pulses can traverse the paper only while the lever, *L*, is in the mercury, and hence a *group* of dots on the paper will represent the vibrations of the wire in the unit of time.

Various electrolytes may be used in the preparation of the paper. A strong solution of potassic iodide, mixed with a small proportion of starch, is very sensitive and easily managed. A strip of paper, strong, thin, with a smooth surface—strips cut from a sheet of book-paper of good quality, not over thick, are excellent—is *moistened* with this mixture. If too wet the dots will run together, if too dry the electricity will not traverse the paper; the strip should be moistened uniformly, but not wet. The record is written by a platinum pen, *a*, in dots of a reddish-brown color. Let it be at once washed in a stream of water, and the expected blue color takes the place of the brown; the fluid is at the same time washed from the paper, leaving the record in a condition to be more permanent.

Or, saturate the paper with a mixture of potassic ferrocyanide and nitric acid, made as follows: To four parts of a saturated cold solution of ferrocyanide, add one part of dilute nitric acid—one ounce acid to five of water. If the color of the mixture is decidedly blue, too much acid has been used; if no hint of blue appears, too little. With this fluid the pen, *a*, should be of copper, and the record consists of brownish-red dots of cupric ferrocyanide. Let the paper be washed to remove the excess of fluid, and the record may be preserved. This substance is less sensitive than the iodide, and not so pleasant to work with, but the dots are more permanent. Records made a year ago can be counted still.

In experiments with tuning forks, the vibrations may open and close the circuit by means of a solid break-circuit represented in Fig. 2. From the prostadof the fork a silk fibre stretches across to a slender vertical spring, *s*, fixed at the lower end, while its upper end rests against the end of a set screw, *t*. The two surfaces in contact are platinized. The spring is slightly bent, and the set screw, pressing against its upper end, holds it in constant tension, and thus forbids it vibrating, except in unison with the fork. Every vibration of the prong is transmitted by the fibre, and compels the spring away from contact with the screw. Putting this break-circuit in place of the monocord, represented in Fig. 1, between the pendulum, *P*, and the register, *R*, the vibrations of the fork record themselves upon the moving paper.

Noticing that the accuracy of Koenig's tuning forks is questioned by Mr. Ellis (*Nature*, xvi. p. 85), I fancied that the testimony of this method would not be without interest. Seizing the earliest opportunity, therefore, I submitted the *Ut*₃ fork, bearing Koenig's monogram, to careful examination. The pendulum was accurately adjusted to hold the circuit one-half a second. The iodide-starch solution, with a battery of ten Bunsen's immersion cells, was used. Fifteen perfectly distinct and easily counted records were taken. Every one of these autographs was found to consist of 128 dots, representing 128 complete vibrations per half second, 256 per second, or 512 according to the French notation.

But the instrument cannot record fractions of a vibration; on the other hand, no complete vibration can escape its registry. Evidently when the rate of the fork is any whole number of complete vibrations, that number must be recorded. Exactly 128 vibrations, for example, would yield invariably 128 dots; 129 would yield 129 dots invariably; but 128 and a fraction vibrations would yield 128 dots in some experiments, and 129 in others, and in this case the mean experiments would be a close approximation to the exact value of the fraction.

Now in the experiments with the *Ut*₃ fork the autograph *invariably* consisted of 128 dots, declaring the rate of the fork to be 256 complete vibrations per second, testifying to the exactness of Koenig's stamp.

* *Proceedings of the Albany Institute*, Vol. 1, p. 80. *Journal of the Franklin Institute*, Vol. lvii, p 44.
† *Journal of the Franklin Institute*, Vol. lvii, "Annual of Scientific Discovery," 1870, p. 162.
‡ Cooley's "Text-Book of Natural Philosophy," p. 299.

THE basis of common salt is chlorine. It is this element which imparts to it its preserving power. The best specimens of rock salt contain more than ninety-eight per cent. of chloride of sodium, while the West India salt contains ninety-seven per cent., the balance being chiefly sulphate of lime and sulphate of soda.

LIGHTING BY ELECTRICITY.*

By ROBERT BRIGGS, C.E.

In the *Journal of the Franklin Institute* for September will be found a letter from M. A. Sartiaux, Assistant Engineer of the Northern Railway of France, addressed to the Secretary of the Institute, from which it appears that at the merchandise station of this railway, at La Chapelle, Paris, they have now in use a system of electric lighting.

For this purpose three magneto-electric machines are employed, but they have made preparation for five machines in the construction of the building and the power of the engine provided.

The machines themselves are "Gramme" of the smaller size, which the circular of the makers describes as requiring 1⅓ horse-power to run at 850 revolutions per minute, at which speed they will produce a light equal to that proceeding from 150 gas-burners burning five cubic feet of 16-candle (the stated quality at Philadelphia) gas per hour. The makers say that this quantity of light will be doubled by careful adjustment of the carbon points, where the light is evolved, and rate the power to be expanded as the light evolved, thus calling for 3⅓ horse-power for the same machine when producing the maximum of light. M. Sartiaux estimates the power at from two horse-power to 2.9 horse-power, basing his computation of cost of light on two horse-power.

The lamps, as the machinery for holding and regulating the feed of the carbon points as they wear away are called, are those of M. Serrin. The carbons are square pencils made from the substance deposited in the retorts used in gas making, ⅜ of an inch square, 8¼ inches long for the positive pole, and 4¼ inches for the negative pole, which burn four hours.

The lamps are placed in three-cornered lanterns, which have solid bottoms, and have a tin top when out of doors, but are open at the top in the halls. The sides are of double glass, $\frac{1}{10}$ of an inch apart, to avoid breakage from cool currents of air. The dimensions of the lantern are 18 to 20 inches on the sides by 3 feet 4 inches to 3 feet 8 inches high. The sides are clouded by zinc white to such height as will prevent the voltaic arch being seen when the lantern is in its place. A large illuminated body is thus procured, at the evident expenditure of light, however, sufficiently reduced in brilliancy to be endured by the eye without injury. The rays emerging above the obscured band on the lantern are reflected, within the hall, by the whitened walls and ceiling, which serve as diffusing reflectors; but out of doors the tin top of the lantern serves rather as a cover than as a reflector.

In the halls, a single lantern placed in the middle, at the height of 16½ feet, gives a general light, without troublesome shadows, sufficient for the recognition and handling of packages, for a radius of 110 to 125 feet. Out of doors, a lantern placed at the height of 20 to 23 feet admits the management of the cars within a radius of 200 to 270 feet.

M. Sartiaux estimates for these three machines and lanterns, running ten hours:

Motive power	$1 27
Mechanic	1 00
Carbons	90
Ten per cent of cost per year, per day	1 26
Oil, repairs, etc.	1 00
Total	$4 73

These figures should be altered to apply to American conditions, and the following will give a liberal estimate.

For three Gramme magneto-electric machines, with Serrin lamps running ten hours per day (or night):

Six horse-power, at 40 cents per day of ten hours*	$2 40
Mechanic in attendance ten hours	1 75
Carbons	1 35
Twenty per cent of cost of electric machinery†	2 25
Total	$7 75

Three lamps × 150 gas-burners × 5 feet × 10 hours,
= 22,500 feet of gas at $2.15 per thousand....... $47 93

This estimate makes electric lighting to cost, at Philadelphia, about one-sixth that of gas lighting wherever the quantity of light required is so large as to make the electric system available.

It may be admitted, however, that in lighting by gas of most public places or buildings, the gaslights themselves may be arranged, and generally are arranged, so that they are not more than ten or twelve feet on the average removed from those persons who require or use the light, while the electric system will demand about twice this average distance. As the quantity of light supplied will vary as the square of the distance from the objects lighted to the source of light, it follows that four times as much light must be provided by this electric agency as is required in ordinary arrangements for gas lighting. (The value of the reflected light from the electric lamps may be accepted to balance the necessary obscuration of direct rays emanating from the voltaic arch.) This assumption of allowance will yet preserve the superiority of electric lighting as half as expensive as gas lighting.

Beside the question of economy, questions as to relative healthfulness, comfort, or safety from fire may be considered.

As regards the first of these, with electric lighting the production of irrespirable gases of combustion—the vitiation of air of a room—almost entirely ceases. The products of combustion which accompany electric lighting are almost inappreciable. The three lamps referred to burn or consume (for some is not burned) 9¼ inches of carbon pencils, ⅜ inch square, per hour. The weight of carbon is possibly an ounce and a half; and the resulting quantity of carbonic acid gas is, if the carbon is really burned, 2½ cubic feet. While for comparison, taking the gas lighting as four times as efficient in practice as the electric, so that 5,625 cubic feet of gas shall be assumed to give as much effective light as the three electric lamps, we have a consumption of 562½ cubic feet each hour; a volume of gas equal to 17.9 pounds, which will produce no less than 227 cubic feet of carbonic acid gas, about 87 pounds of vapor of water. The quantity of oxygen taken from the air for burning gas is 95.5 pounds, while the air needed for complete combustion—that is, twice as much as contains the oxygen really burned up—is 11,600 cubic feet per hour.

The comfort of a room is materially affected by the heat emanating from lights. With electric lighting it may not be proper to take the heat of combustion of the carbon points as the sole heat evolved; for this, when computed, amounts to only the equivalent to heating 1,200 pounds of water one degree each hour, or 20 units per minute. But there is a more accurate way of regarding the heat of electric lights. Whatever may be the source of power which drives the magneto-electric machines, or however wastefully or economically the prime mover may have been used, the quantity of heat produced by electricity or otherwise *from* the machines cannot exceed the theoretic equivalent of heat. One pound of water heated one degree Fahrenheit represents 772 pounds lifted one foot in height. Having 6 horse-power as the power needed to drive the three Gramme machines, we transform

* American Architect and Building News.

* The above price is $125 per year per horse-power, and is a full profit rate for power supplied in small quantities.
† This percentage is to cover interest, repairs, oil, etc.

the horse-power into pounds lifted one foot high each minute, by multiplying by 33,000, giving 198,000 foot-pounds, and dividing by 772 foot-pounds, it follows that 256¼ pounds of water heated one degree represent all the heat *possible to proceed* from the motive power imparted. Much of this heat may be lost in friction, or in the heating up of the machines themselves; but for this estimate let us accept this quantity of heat as given possibly from electric lamps each minute, in lieu of the 20 units which proceed from burning of carbon points. The gas consumption has been accepted as 562½ cubic feet per hour—9.375 cubic feet per minute; which in burning will give out 10,125 units of heat, to be dispersed by radiation, or to pass off with the products of combustion. These figures show the relative heating effects of electric and gas lighting, with every assumption in favor of the latter (and particularly the assumption that only one-fourth as much light is to be supplied by gas lighting), to bear the ratio of *one to forty*. In these figures, also, we have taken the two horse-power per machine given by M. Sartiaux in his estimate, while the Gramme machine makers assert that 1½ horse-power suffices; we incline to accept which assertion as the result of actual trials. Accepting this value, and supposing a case where the gaslights are placed above the ceiling of a room or hall, so that electric lighting would apply on an equality of distance from the audience, the heat proceeding from electric lamps would compare with that from gaslights, as *one to one hundred and ninety-two*.

The question of relative safety from fire of the two systems, in theaters especially, is too important not to merit remark; but after bringing it before the reader no comment is needful. The dangers of leaky gas-pipes and fixtures, disastrous explosions, the feeding of flames by gas when accident occurs, all disappear before the harmless wires which convey the electric current to sources for illumination.

With all these advantages there remains yet another. The electric light is the nearest possible to the natural one of the sun. With proper disposition of lamps, the room or space is filled with light, so that the ceiling, walls, floor, or the objects within a room become, as they do in daylight, sources for reflected light, diffused and distributed without glare or fatigue to the eye. Colors have their natural values and tints. The gratification of the most delicate sense is not the least of the promises in the future perfection and application of electric lighting.

The Crystalloids and Colloids of Honey.—By subjecting filtered honey to dialysis in a parchment dialysator, E. Dietrich found that the surrounding water had acquired a pale yellowish color, and, on evaporation, yielded 50 per cent. of crystalloids in the form of a clear little-colored golden yellow honey, which did not crystallize from alcohol, but had such a fine taste and floral odor as the author had never before observed in honey. The colloids remaining in the dialysator contained slimy floccules, were destitute of honey-like odor, and had an insipid sweetish taste. If the loss by colloids was not so great, the author would recommend the purification of honey by dialysis.—*Chem. Centralblatt.*

South German mills of our day. It consists of a horizontal sieve which grades the middlings as to size. Immediately below the sieve, a fan forces air through the graded middlings, the air current carrying along the lighter particles, whereas the heavy purified middlings drop into the hopper for further treatment. This primitive machine was, later on, reconstructed, and used more especially in the old mills of Austria and in the vicinity of Vienna, and is well known throughout the mills of these districts under the name of *Wiener Staeupe.*

In France, Italy, Spain, and other countries, mechanical purification of middlings commenced in the beginning of the present century; but long before this, hand sieves had had been employed in these countries for the same purpose. The milling system of these countries, and particularly that of France, known there under the name of *mouture economique*, is the one which approaches nearest to, or rather is identical with, the so-called "New Process Milling" of the United States; and we find printed descriptions of this kind of milling in various treatises of an early data, such as those of Pouillet, LeBlanc, Benoit, Roret, and others, some authors dating from the last century.

In our days the number of different constructions for middlings purifiers is countless, and it would require too much of our time to enter into a detailed description of them. But the principle in all of them is to extract as much fluff and small particles of bran as possible. There is, however, a marked difference in the treatment of small middlings and large middlings, and the machines for the latter operation differ in principle from those used for the purification of small middlings. This is a point which millers must keep in view when adopting the system of gradual reduction.

I think it necessary to state here that I consider the word "middlings" as embracing all kinds of granular starchy particles, from the largest size obtained by the system of high grinding to the finest size produced by other systems; and it is a misconception to think that middlings produced under the flat-grinding system are different from middlings produced under the high-grinding system. Since the size of middlings produced by the high-grinding system varies from No. 00 to No. 8 (Swiss silk cloth), and that of middlings produced under the flat-grinding system varies from No. 4 to No. 8, of course the middlings of the last-named system are more uniform in size; but on comparing the middlings of the same size of both systems, no difference will be detected as to their nature.

The high-grinding millers, having for their aim the greatest possible production of large-sized middlings, neglected, to some extent, the purification of the small middlings, such as are produced by the flat-grinding system; whereas, in France, where flat-grinding produced only small middlings, the purification of the latter received a greater degree of attention. Machines like those of Benoit, Cabanes, and Perrigault, introduced into French mills since 1830, have not been excelled in their principle of action by any of the later purifiers, and have been adopted throughout the world with a greater or less number of modifications.

On the other hand, quite a distinct mode of operation is required for an efficient purification of large-sized middlings. The grading and sizing of these middlings is far more important than in the case of those produced by the flat-grinding system, and therefore the construction of the machines intended for this purpose is of a more elaborate character, combining sieves, exhaust blast, centrifugal action, and grading as to specific weight. The system of gradual reduction which has been treated of in former articles requires a larger number of purifiers of various kinds, as the production of middlings is greater, and their size varies considerably. In this system, the grading and sizing of middlings is one of the most essential features, and the more elaborately it is carried out, the more remunerative will it prove.

By gradually reducing wheat we are able to size the middlings not only as to volume, but also as to their location in the kernel, and thus according to their color. Keeping this in view, each class of middlings produced by the different grinding operations will be treated by itself, and consequently the number of machines employed will be comparatively large, although their dimensions are smaller, the work being equally distributed over a greater number of machines.

The middlings once sized, graded and purified, are not to be mixed again, but ought to be subjected separately to the grinding action, so as to produce the best possible quality of flour, which may afterwards either be kept separate as a high, choice brand, or mixed according to the requirements of the market. Complicated as these operations may appear at first sight, in reality the system which they compose is as simple as any other mode of milling in existence, and can be made to do perfect work automatically. The advantage of keeping the various grades of middlings and flour separate until the end of the process must be clear to every miller who has experienced how convenient it is to have the largest control over his production of flour.

With very few exceptions the grinding of middlings has been accomplished until the last three or four years entirely by millstones, and, in fact, even now the millstone is mainly used for this purpose. Rollers, however, are doubtless a much better instrument for performing this operation; and taking into consideration the advantages which they offer over the millstone, it seems rather difficult to imagine a reason why their adoption by millers is going on so slowly, comparatively. Rollers for the grinding of middlings were employed as early as 1835 in German, Hungarian, and Italian mills, and especially in the "Pesther Walz Muhle" at Pesth, in Hungary, where the system of gradually reducing the wheat has been in successful operation from that time to the present. However, the construction of the roller machines employed at that time was so complicated, and the machines subjected to so much wear and tear, that the system never grew into general use until 1874, when F. Wegmann, a miller of Naples, Italy, brought into the market his Porcelain Roller Mill with self-acting pressure, which since that time has nearly revolutionized milling in some portions of Europe, and attracted considerable attention in this country. —*American Miller.*

Portable Food for Horses.—The *Journal de Saint Petersbourg* furnishes the following details regarding the preserved food for horses, prepared in the event of a scarcity of oats, or in case the transport of food as used at present should prove too difficult. This food is composed of pounded oats and gray pea flour, mixed with hemp seed oil and salt. The paste obtained by this mixture is then cut up into thick cakes of about four inches in diameter, pierced with small holes to assist the soaking in water. On being taken from the oven these cakes are strung upon wires so that each wire holds the daily ration for a horse. Each ration of the weight of four pounds is equal in nutriment to ten pounds of oats. It is stated that the horses are extremely fond of these cakes, whether soaked in water or quite dry; and although when fed exclusively on these cakes they become thinner in appearance, they do not lose any of their strength though hard worked.

"JUNO:" AN IMPROVED SHORTHORN COW—4 YEARS OLD—BRED BY MR. ROBERT COLLING, NEW DARLINGTON, ENG.

THE GRANULATION OF WHEAT.

By Oscar Oexle, C. E.

Ever since wheat has been reduced into flour by artificial means, a certain quantity of middlings, *i. e.*, starchy particles of different sizes, not entirely pulverized, has been produced. The old Egyptians, as well as the Greeks and Romans, had to contend with this product, as we learn from the historical accounts of Pliny, Herodotus, and others. The ancient Romans were acquainted with the purification of middlings by means of hand-sieves and air currents; and until our day this principle of purification has remained unchanged, although vastly improved by mechanical appliances of different kinds.

The fact that middlings, when purified of the bran particles intermingled with them, yielded, when ground, a first-class flour, was also known many hundred years ago; but it was only in the last century, when mechanical skill and industrial enterprise gave a fresh impetus to trade of all kinds, that the treatment of middlings was carried on in some parts of Europe with special attention, forming quite a distinct branch of the milling industry. In Switzerland, Germany, and Austria, during the 17th and 18th centuries, where wheat was already reduced to flour by the high-grinding system, the machines used for the purpose of purifying middlings consisted mainly of grading sieves and subsequent air blasts. One of the oldest specimens of this apparatus is the so-called *Schweitzer Staeupe* or Swiss Winnowing Machine, which may still be found in many of the Swiss and

STAR OR STAR-MIST.

By Richd. A. Proctor.

A remarkable discovery has been made by the astronomers of Lord Lindsay's observatory at Dunecht—a discovery the true meaning of which is not as yet fully perceived. It may be remembered that some nine months ago a new star, as it was called, made its appearance in the constellation Cygnus. This object shone out where before no star had been known to astronomers—not merely, be it noticed, where there was no visible star, but where none was recorded even in lists like Argelander's "Durchmusterung," containing hundreds of thousands of telescopic stars. It was not, however, altogether impossible that some small star within moderate telescopic range had existed in the spot where the new star shone out, and that in some way this small star had escaped observation. This seemed the more likely because the new star had appeared in a part of the heavens very rich indeed in telescopic stars; at any rate, astronomers had reason to believe that they would be readily able to determine the question with a high degree of probability by watching the star as it gradually faded out of view. For a "new star" which had shone out in the constellation of the Northern Crown in May, 1866, and had been identified with a tenth magnitude star in Argelander's list, had gradually faded out of view, and growing yet fainter had sunk through one telescopic magnitude after another until it shone again as a tenth magnitude star only. Since that star had resumed its former lustre, or rather its former faintness, it seemed not unreasonable to conclude that so also would the star in Cygnus. We shall presently see how far this expectation was from being fulfilled.

During its time of greatest observed brilliancy the new star in the Swan was very carefully watched by spectroscopists. The results were in many respects interesting. The star in the Crown had shown the bright lines of hydrogen, superposed upon a faint rainbow-tinted spectrum, which understood to signify that around a real, though probably a small, sun some outburst of glowing hydrogen had taken place, the chief part of the star's new light being due to this outburst. The same bright hydrogen lines were seen also in

the case of the star in Cygnus. But in addition to them other bright lines were seen, which seemed to be identical with those belonging to the solar sierra (or, as many astronomers unclassically call it, the chromosphere) and corona. This, at least, was the opinion of M. Cornu, of the Paris Observatory. Herr Vogel, who began his observations on December 5, when the star was between the fourth and fifth magnitude, and continued them until March 10, when the star had sunk below the eighth magnitude, does not agree on this point with M. Cornu, since a line not agreeing with any known line in the spectrum of the sun's sierra was clearly visible from the beginning in the spectrum of the new star. But the most interesting point in connection with Vogel's observations, confirmed also by Mr. Copeland at the Dunecht Observatory, and by Mr. Backhouse, of Sunderland, was this—that, as the new star died out, not only did the rainbow-tinted background of the spectrum fade gradually out of view, but the relative lightness of the bright lines steadily changed. At last, on March 10, very little was left of the spectrum which Cornu and Vogel had seen in December. The blue and violet portion of the spectrum had faded entirely from view, a dark gap had appeared in the green, and a very broad dark band in the blue. Of the bright lines two only remained. One, the F line of hydrogen, in the green-blue, which had been singularly conspicuous last December, was now very bright—in fact, nearly the whole light of the star seemed at this time to come from this bright line.

Now, the changes which had thus far taken place were altogether unlike those which had been noticed in the case of the new star in the Northern Crown. As that star faded from view the bright lines indicative of glowing hydrogen died out, and only the ordinary stellar spectrum remained. In the case of the star in Cygnus, the part of the spectrum corresponding to the stellar light—that is to say, the rainbow-tinted streak crossed by dark lines—faded gradually from view, and bright lines only were left, at least as conspicuous parts of the star's spectrum. This body, then, did not seem to be returning to the stellar condition at all, but actually fading out into a nebula. Not only so, but the lines which still remained conspicuous last March were lines known to belong to the so-called gaseous nebulæ. One of them, that which had been the faintest, but was now the brightest, corresponded to the nitrogen line of the nebular spectrum; the other, which was still conspicuous, though faint, corresponded to the hydrogen line of nebulæ.

That, however, was by no means the closing chapter of this singular history. Vogel seems to have ceased from observing the star's spectrum—strangely enough, at the very time when the most remarkable part of the process of change seemed to be approaching. At the Dunecht Observatory also, through pressure of work relating to Mars, no observations were made for nearly half a year. But on September 3, Lord Lindsay's 15 in. refractor was turned on the star. In the telescope a star was still shining, but with a faint blue color, utterly unlike that of the orb which had shone out so conspicuously last November. Under spectroscopic examination, however, the blue star was found to be no star at all, if we are to regard those orbs only as stars which present a spectrum in some degree analogous to that of our own sun. We regard Sirius as a sun, though in his spectrum the lines of hydrogen are abnormally strong; and, passing over the class of stars more closely resembly our sun, we regard as a true star the orange orb Betelgeux, though the lines of hydrogen are wanting in its spectrum; nor do we reject from among the suns those stars which, like Gamma of Cassiopeia, show the lines of hydrogen bright upon a fainter rainbow-tinted spectrum. There is yet another order of star—those whose spectrum presents bright bands with faintly lustrous intervals, which again we regard as true suns, though they differ doubtless notably from our own. But we have been in the habit of regarding all the star cloudlets, whether consisting of multitudinous stars, like the clusters, or of luminous star-mist, as differing *toto cœlo* from the sun and from all his fellow-stars. The clusters indeed give a spectrum resembling the sun's, and we regard them as different only because of their clustering condition. But the nebulæ which Sir W. Herschel regarded as consisting entirely of luminous vapor, and which spectroscopic analysis has proved to be so constituted, we have regarded not merely as different because of the structure and arrangement of their component parts, but as differing altogether in constitution. Now, the object seen as a faint blue star showed the same spectrum as these gaseous nebulæ, or rather as the very faintest of these nebulæ. For most of them show three bright lines; only the faintest shine with absolutely monochromatic or one-tint light. The star in Cygnus now shines like these faintest of the gaseous nebulæ—that is, with a light which, under spectroscopic analysis, presents only one bright line.

The words in which Lord Lindsay announced this remarkable discovery are these: "*There is little doubt but that the star has changed into a planetary nebula of small angular diameter*," though, he goes on to say, "such a result is in direct opposition to the nebular hypothesis." On this last point I venture to express dissent from Lord Lindsay's opinion, which is in any case a somewhat bold inference from a single observation. Assuredly the discovery just made is in direct opposition to a certain argument, derived from the gaseity of nebulæ, in favor of the gaseous hypothesis of Laplace—an argument which had always appeared to the present writer insufficiently established. But the nebular hypothesis, regarded not merely in the form suggested by Laplace (in which form it was utterly inconsistent with physical facts now known), but in the wider sense which would simply present our solar system in the remote past as in a nebular state, without defining its nebulosity as due either to gaseity on the one hand, or to a mixed meteoric and cometic constitution on the other, has most certainly not received a shock, but rather receives strong support, from Mr. Copeland's observation. A theory of the evolution of the solar system, advocated by me during the last seven years, according to which the solar system had its origin in meteoric and cometic aggregation, requires that during the long ages through which the process of development continued there should be occasional outbursts of light and heat at the growing center of the system, and a widely distributed emission of light and heat in moderate degree from the rest of the system, even to its outskirts. The intense heat, imagined by Laplace as pervading the entire gaseous mass, extending originally far beyond the path of the remotest planet of our system, would require, indeed (if it were a physical possibility in other ways), that the spectrum of a developing solar system should be uniformly that of gaseity for millions and millions of years. If it had been found or could be proved that the gaseous nebulæ are in a state of intense heat, Laplace's gaseous hypothesis would have had one powerful argument in its favor. This argument has been strongly urged by those who have taken that special view of the gaseous nebulæ which the recent discovery shows to be erroneous. But those who have maintained, as I have, that in the gaseous nebulæ we probably "see vast systems of comets traveling in extensive orbits around nuclear stars," will find confirmation, not disproof, in the discovery lately made, especially when considered in combination with the circumstances that Professor Wright, of Yale, has found the cometic spectrum to be emitted by meteoric masses exposed to moderate heat; while, under slight changes of condition, the cometic spectrum of bright carbon bands appears to give place to the nebular bright-line spectrum.

However, speculation apart, we have in the discovery just made a most important fact for our guidance—the fact, namely, that a body which to ordinary observation has been in all respects like the star in the Crown, and even under spectroscopic observation alone for a while with true stellar light, has dwindled into a nebula giving a spectrum which has heretofore been regarded as indicative of ordinary gaseity.—*English Mechanic.*

[ACADEMY.

ANTHROPOLOGY.

ONE of the most interesting discoveries of stone implements which have been recorded for a long time past has recently been made in the West of England. This discovery was brought before the British Association by Dr. John Evans, who had just visited the locality where the implements in question had been found. It appears that a part of the Southwestern line, in the neighborhood of Chard, had been ballasted with gravel from a pit near Broom, in the valley of the Axe; and it was in this gravel that the inplements were detected. They are decidedly of palæolithic type, mostly of flat ovoid shape, and the river gravel which yielded them appears to be a quaternary deposit, like our other implement-bearing gravels. It is notable that the implements are not fashioned out of ordinary flint from the chalk, but of chert obtained no doubt from the Blackdown beds, which are a set of deposits representing apparently both Upper and Lower Greensand. About fifty of the implements are exhibited in the Albert Museum at Exeter, having been collected by the accomplished curator, Mr. D'Urban, who has paid great attention to the arrangement of the ethnological part of the museum.

PRE-HISTORIC MEN.

With so distinguished an anthropologist as M Paul Broca at the head of the French Association for the Advancement of Science, it was only to be expected that anthropology would form the staple of the presidential address delivered at the opening of the recent meeting at Havre. In sketching the history of scientific opinion on the famous question of the antiquity of man, M. Broca admitted that the evidence for the existence of man in Tertiary times is not yet sufficiently strong to amount to a satisfactory proof. The Abbe Bourgeois' "Miocene man" is, therefore, not yet on the platform of science. Few Englishmen, we need hardly say, ever supposed he was; but nevertheless it is satisfactory to hear a distinguished French anthropologist of advanced views joining in this opinion. Perhaps the most interesting part of M. Broca's address was his clear description of the three races of pre-historic man whose bones have come down to us, and of whose physical characteristics we consequently know something. The oldest of these three types of man is the *Canstadt* race, so called from Canstadt, near Stuttgart, where some human remains were discovered in the last century, though they remained for many years in the Würtemburg collection before their interest was fully realized. It is to the ancient race of Canstadt that we must refer the celebrated Neanderthal skull. The Canstadt people were of short stature, with very long heads, much flattened at the top, the flattening being mainly due to the retreating forehead. Technically they would be described as *dolichoplatycephalic*. Marks of inferiority are conspicuous in every part of the skull, and M. Broca considers that the race must have been more savage than any in existence at the present day. These people date back to the Quaternary period; and, to judge from the number of localities in which human remains of the same type have been found, they must have had a very wide geographical extension. Another type of prehistoric man is that known as the *Cromagnon* race, since some typical remains were found in 1868, in the Cromagnon cavern in the Dordogne. These represent a dolichocephalic or long-headed people, like those of Canstadt, from whom, however, they differed by their vastly superior organization. In fact, the Canstadt skull is of so elevated a type that no one at the present day need be ashamed to own it. Yet the race flourished as far back as the second half of the Quaternary period, and was at its zenith during the reindeer age. It is notable that the Cromagnon people were flat-shinned, or platycnemic; not exceptionally, as among certain peoples at the present time, but constantly; so that platycnemism with them was an ethnic characteristic. Yet a third type of prehistoric man may be recognized in the remains which were discovered ten years ago near Furfooz, in Belgium, whence it is known as the *Furfooz* type. The men of the race were extremely short, not taller perhaps than the present Lapps. Their type of cranium is decidedly lower than that of the Cromagnon people, and appears to approach rather to the Canstadt type. The head is rounded, but not decidedly brachycephalic, belonging rather to the *misatocephalic* group, or that class in which the cephalic index is between the brachy- and dolichocephalic indices. This race arrived in Belgium at the close of the reindeer period. But, though greatly inferior in cranial development to the Cromagnon race, the Furfooz people were acquainted with the art of making pottery, an art of which the Cromagnon folk are believed to have been ignorant. For an English abstract of M. Broca's masterly address, the reader may be referred to a recent number of *Nature.*

ATMOSPHERIC FLOATING IRON.

THE attention of modern physicists has been directed to the particles of dust which are at all times floating in the air. Many of them come from the soil, but some are characterized by a special chemical composition and form, which show that they have reached us from the interplanetary spaces. In 1825, Brande examined, during a number of successive months, the chemical substances contained in the rain water, near Salzüflen, in Germany He found various organic and mineral substances, among which oxide of iron was especially noteworthy. In 1851, M. Barral, in a series of analyses of the rain water collected at the Paris observatory, distilled 5·57 litres of water, which gave him a dry, yellowish residuum, weighing 183 milligrammes, a portion of which was insoluble in water, alcohol or ether. Its solution in *aqua regia* gave all the reactions of iron The idea of attributing these minute particles of iron to a fall of cosmic dust seems first to have occurred to Ehrenberg. After analyzing numerous specimens of dust, which had fallen upon vessels at Malta and in the Indian Ocean, he at first supposed they were of African origin; but noticing their difference from any of the African sands in color, the great geographical distances which they must have travelled according to his first hypothesis, and the amount of oxide of iron which they contained, he broached the theory that they had fallen from the upper layers of the atmosphere.

This hypothesis was adopted and extended by M. Nordenskjöld. In a letter to M. Daubrée, Sept. 9, 1872, he mentions finding, in a careful analysis of snow, soot-like particles, containing organic matter and minute pellets of metallic iron. Thinking that this dust might possibly have come from the chimneys of Stockholm, he requested his brother, who lived in a remote part of Finland, to collect and send him some snow, in which he found particles of the same description. In 1873 and 1874 he repeated his observations at Spitzbergen, and on the glacier of Inlandis, in the interior of Greenland, finding magnetic iron, oxide of iron, nickel and cobalt, which satisfied him of "the existence of a cosmical dust, falling imperceptibly and continually."

In 1875 and 1876 Gaston Tissandier and E. Young independently collected dust from the towers of cathedrals and other elevated places, which they subjected to chemical and microscopic examinations. By means of a magnet they discovered small spherical corpuscles with a slight roughness, which made many of them somewhat bottle shaped, resembling, in appearance, iron which has been reduced to an impalpable powder, and burnt in a hydrogen flame. Young also collected snow at Montreux, Les Avants, Hospice of St. Bernard, and Chanossal, being careful to avoid the lowest layers, which might have absorbed something from the soil, and the upper layers, which might have been stained by vegetable débris. The residues from the evaporation of the several samples were first dissolved in distilled water, which separated the chlorides, then in pure chlorhydric acid which showed no traces of iron. Chemical reagents showed the presence of iron in each of the residues, and there were often irregular particles which were attracted by the magnet. He found none of the characteristic globules, but M. Tissandier found them in the sediment of some snow which his brother collected on the side of Mont Blanc, at the Col-des-Fours, at a height of 2,710 metres.

M. Young proposes to continue his observations on a larger scale. He feels justified already in affirming that the interplanetary spaces are not destitute of solid materials, but they contain very minute metallic particles; that these particles, when drawn into our atmosphere, play an important part in the dispersion of light, as Tyndall has shown by his experiments; that they help to explain the luminous trains of bolides and the peculiar spectra of auroræ-boreales, and that these microscopic aerolites, by their daily arrival, must increase the earth's mass, so as to afford an explanation, as M. Ch. Dufour has shown, of the moon's secular acceleration. He closes his paper with the following conclusions:

1. That iron exists in all the dust which has been accumulated, in church towers, by the winds of ages.

2. That this iron, floating in the atmosphere, is trapped in its fall by the snow, in which it is always found.

3. That its globular form indicates that it has been raised to a high temperature.

4. That facts tend to prove its celestial origin.

5. That it plays an important part in the physics of the globe, but that science, in order to fully understand it, should seek to estimate the phenomenon quantitatively, and to study it in its variations.—*Bulletin de la Societe Vaudoise.*

HOW TO MOUNT SPIDERS.

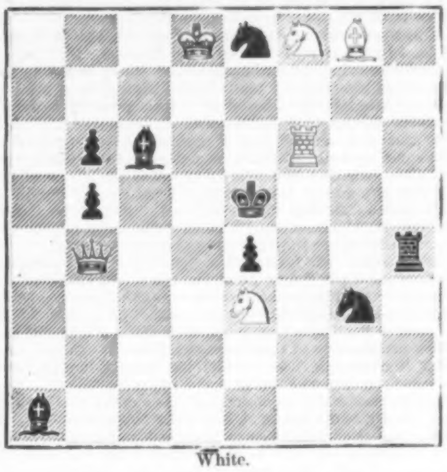
DIRECTIONS for mounting portions of spiders for microscopical work are given by Mr. C. Williams, of Bristol, in *Science Gossip*, from which we make the following abstract: As regards those spiders which most concern the microscopist, I may mention three groups: 1. The house spider; 2. The garden spider; 3. The wandering spider. The latter two species, which are to be found in our gardens, though well adapted for mounting purposes, are not so easily obtained as our friends that take up their board and lodging with us in the house. It is no difficult matter to find the house spider; any old cupboard or disused room will furnish plenty. If one keeps his eyes about him of a wet day, he is sure to see some large specimens crawling either on ceiling, wall, or floor. Having found your spider, the next thing is to catch him, and then kill him. A pair of curved forceps is what I generally use to catch specimens with. The best way of killing them is with the poison bottle. Let me advise my readers who are going to mount spider preparations, to dissect, as quickly as possible after death, the bodies of the spiders they have captured; for, if kept long, they shrivel up, and become very difficult to manipulate. The dissection of a spider is by no means difficult, as those objects which the microscopist desires are all external, so to speak, and visible to the naked eye. Place the spider on your dissecting board, and pin it down; then with a pair of sharp, fine scissors, remove the eight legs, and put them aside; next with a scalpel cut off the spinnerets, which are to be found at the extremity of the abdomen, and are four in number. Then remove the maxillæ; and lastly cut away the mandibles, if possible, with eyes attached. This plan of mounting the eyes and mandibles I have found to be highly satisfactory in every way. Having carefully dissected all the parts, put them in a gallipot, and pour liquor potassæ upon them. The best jars are those which Liebig's extract of meat is sold in. In about 3 to 6 days, take the preparations from the liquor potassæ, and place them in a saucer full of distilled water, and well wash; then press between two pieces of thin glass, the spinnerets excepted; and then wash again, always using a camel's hair brush to cleanse the specimens with. Dry the specimens on clean blotting-paper, and then place in another gallipot full of spirits of turpentine. In a day or two you may mount. You must be careful that the mandibles and eyes are fairly flat, and that the jaws are not gaping too much apart; the novices will find this difficult of attainment; but, persevered in, good results will be obtained. In mounting the feet and legs, see that the combs of each foot are clear and distinct. The maxillæ are not particularly interesting, but should be mounted together. Be careful not to flatten the spinnerets by pressure. The best fluid for mounting in is damar; but if there can be found such a wonder as a microscopist who ignores its utility, why then let him use Canada balsam.

SCIENTIFIC AMERICAN CHESS RECORD.

[All contributions intended for this department, may be addressed to SAMUEL LOYD, Elizabeth, N. J.]

PROBLEM No. 27. BY W. A. SHINKMAN. First Prize in the *Free Press* Tourney, No. 2.

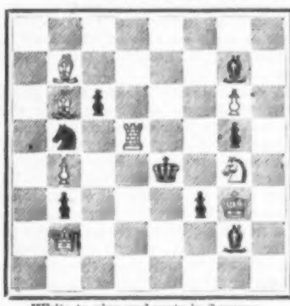
Black.



White.

White to play and mate in two moves.

HERR HARWITZ OF PRUSSIA.



White to play and mate in 2 moves.
W. A. SHINKMAN.

NOTICING from our foreign exchanges that Herr Harwitz has returned to the chess world after an almost total retirement of about twenty years, we take pleasure in presenting his portrait to our readers as we saw him many years ago, during our first visit to Paris. We dare say advancing years have given him a more venerable appearance, little as it seems to have impaired his wonderful chess powers.

For upwards of a quarter of a century Mr. Harwitz has stood prominently forward in the ranks of acknowledged chess masters; and at the time of his defeat by Morphy, from whom he succeeded in scoring two games out of a match of seven, he was by many considered the most brilliant of European players, having won many important matches, prominent among which may be mentioned his famous matches of 1852–3 against Williams, in one of which he stood 7 to 2, and 3 drawn, and in another 7 to 0, 3 drawn. More noted, however, was his remarkable match with Lowenthal in 1853–4, which at the commencement seemed to promise such an overwhelming defeat, the score standing Lowenthal 9, Harwitz 3. Mr Harwitz having forfeited one game, and feeling that his lack of success was due to ill health, forfeited another game, and took a recreation at the seashore, giving his mind a rest from all chess matters, returning from which he scored the remaining games, and won the match by a total of Harwitz 11, Lowenthal 10, drawn 12. We give the decisive game of this remarkable contest, with notes by Mr. Harwitz, from the *British Chess Review* of that date, of which Mr. Harwitz was then the editor.

FREE PRESS PRIZE PROBLEM TOURNEY NO. 3.

THE following prizes are offered to all the world for free competition:

For the best set of three original problems in any number of moves from two to four:

First Prize	$15 00
Second Prize	10 00

SPECIAL PRIZES.

Best two move problem	$4 00
Best three move problem	6 00
Best four move problem	6 00

Should any of the special prizes fall to the winner of the first or second prize a special prize will be awarded to the best problem in that number of moves by a non-prize bearer.

George E. Carpenter will judge the problems according to the following standard:

1. For elegance or beauty of design } Twenty points.
2. Originality of design }
3. Difficulty of solution "
4. Accuracy of construction }
5. Elegance of construction } "

Thus giving to a first class problem sixty points.

No composer shall enter more than one set for competition.

Each set of problems shall bear a motto or a device. The tourney will close March 30th, 1878, and the award of the judge will appear in *The Free Press* simultaneously with the publication of the last set.

SOLVERS' TOURNEY.

FOR the greatest number of correct solutions to the Tourney problems—received within three weeks from the date of publication—the following prizes will be given:

First Prize	$5 00
Second Prize	4 00
Third Prize	3 00
Fourth Prize, the weekly *Free Press* for one year	2 00
Fifth Prize, the weekly *Free Press* for six months	1 00

THE DECIDING GAME IN THE MATCH BETWEEN HARWITZ AND LOWENTHAL.

LOWENTHAL. WHITE.	HARWITZ. BLACK.
1. P to K 4	1. P to Q B 4
2. B to Q B 4	2. P to K 3
3. Q Kt to B 3	3. P to Q R 3
4. P to Q R 4	4. Q Kt to B 3
5. P to Q 3	5. P to K Kt 3
6. P to K B 4	6. K Kt to K 2
7. K Kt to B 3	7. P to Q 4
8. B to Q R 2	8. K B to Kt 2
9 Q B to Q 2 (*a*)	9. Kt to Q 5
10. Castles (*b*)	10. Castles
11. P to Q R 5 (*c*)	11. P x P
12. P x P	12. Q B to Q 2
13. P to K 5	13. Q B to B 3
14. K Kt to Kt 5	14. Q to Q B 2
15. K B to Q B 4	15. Q R to Q sq
16. Q R to Q B sq (*d*)	16. K Kt to Q 4
17. B x Kt	17. P x B
18. K R to K sq	18. K R to K sq (*e*)
19. Q to K Kt 4	19. P to K R 3
20. K Kt to B 3	20. Kt x Kt ch (*f*)
21. Q x Kt	21. K to R 2 (*g*)
22. Q to K B 2	22. P to Q 5
23. Kt to K 4	23. B x Kt
24. R x B	24. Q to Q B sq (*h*)
25. Q R to K sq	25. Q R to Q 4
26. P to K R 3	26. P to K R 4
27. Q to K B 3	27. K to Kt sq
28. P to Q B 4 (*i*)	28. P x P *en pas.*
29. B x P	29. P to Q B 5
30. R to Q 4	30. R x R
31. B x R	31. R to Q sq
32. Q to K 4	32. Q to K 3 (*k*)
33. B to Q Kt 6	33. R to Q 2
34. R to Q B sq	34. P to K Kt 4 (*l*)
35. R x P (*m*)	35. R to Q 8 ch
36. K to B 2	36. P x P
37. R to Q 4	37. R x R
38. B x R	38. P to K B 3
39. Q to K Kt 6	39. Q to Q 2
40. B to B 3	40. P x P
41. B x P (*n*)	41. Q to Q 7 ch
42. K to B sq	42. Q to Q B 8 ch
43. K to K 2	43. Q to K 6 ch
44. K to B sq	44. Q x B
45. K to Kt sq	45. Q to K 8 ch, and white resigns.

HERR HARWITZ OF PRUSSIA.

NOTES BY HERR HARWITZ.

(*a*) If, instead of this move, white had played P to K 5, black would have replied with P to K B 3.

(*b*) Had he taken Kt with Kt, black, by retaking with his B, would have prevented white from castling for some time.

(*c*) Intending to play Q Kt to R 4.

(*d*) Previous to playing out the queen.

(*e*) Perhaps Q R to K sq might have been stronger.

(*f*) This move was made with the view to capture Q R P, but on a subsequent and careful re-examination black found it unsafe, consequently this Kt should have been retreated to B 4.

(*g*) To prevent the advance of white's K B P, in which case, having his K R P protected, K P might safely be taken with B.

(*h*) Again black fears the advance of adverse K B P.

(*i*) This is much better than P to K Kt 4

(*k*) B to K B sq, with the view of taking B with R, and then playing R to Q B 4, looked promising, but would scarcely have succeeded against so powerful an opponent.

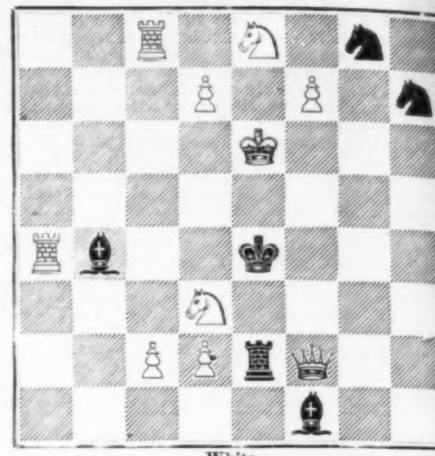
(*l*) A potential move, completely breaking white's center pawns.

(*m*) This move proved to be the longest during the match, it having occupied a period of forty two minutes, which caused the forfeit of a triple fine.

(*n*) Overlooking, very unaccountably, the loss of a B, which it involves.

PROBLEM No. 28. BY W. A. SHINKMAN. First Prize in *Free Press* Tourney, No. 2.

Black.



White.

White to play and self-mate in two moves.

SOLUTIONS TO PROBLEMS.

No. 21.—BY N. MARACHE.

WHITE.	BLACK.
1. B to K 7	1. K x R
2. B to Q B 6 mate.	

No. 22.—BY N. MARACHE.

WHITE.	BLACK.
1. R to K 6	1. P to K 5
2. B to B sq	2. P checks
3. K to B 2	3. P to K 7
4. R x P	4. K to B 5
5. R to K 4 mate.	

LETTER "P."—BY J. WILKINSON.

WHITE.	BLACK.
1. P to K 8 queens	1. R x R
2. Q to R 4 ch	2. R to B 7
3. Q x R mate.	

PROBLEM FROM THE PAGE OF HISTORY.

THE position on Mr. Harwitz's chess board gives the clue to this problem, and shows that although the king is mated in the middle of the board with Kt and Rooks, yet it could not occur in actual play, which proves that the little curate had been playing *points* on his friend, who was justly astonished at the critical position of his king, and in asking how it came so could well vow "to tell it to neither king, rook nor knight."

THE DETROIT FREE PRESS PROBLEM TOURNAMENTS.

IN our issue of Aug. 25 we gave the problem by Harry Boardman that carried off the prize in the First Tournament of this series. This week we give the two problems by W. A. Shinkman that received the first prize in "Tourney No. 2." The second prize was won by Johan Berger; the third prize by Robert Braune. Three prizes being offered for the best sets of two problems, one a direct, the other a self mate, both limited to two moves.

The indefatigable Mr. Bull is determined that the problemists shall not have a rest, and, as will be seen by the present programme, is already out with his Third Tourney, which, like its predecessors, will undoubtedly be a great success, and deserves the encouragement of our problemists, and will be a favorable opportunity for Mr. Andrews and Meyers to cover themselves with glory. Mr. Bull has also inaugurated a solvers' tourney, so that critics may prove their skill. It is very satisfactory to us as umpires in the *Boston Journal* Solving Tourney, that Dr. Moore has openly carried off the highest prize in both the *Free Press* solving contests. We would like to take him for a partner, and solve a match against any other team in the world for a suitable trophy. Now, don't all speak at once, for only a score or two of matches could be accepted, but that many will be agreeably accommodated. Arrange your own terms, gentlemen.

A CORRESPONDENT of the *British Chess Review* says:

"It would please us extremely to see the game more general among the fair sex, as we believe it would materially add to their social enjoyment and influence. We know of more than one charmer who has laid her snare over the chequered board, and after combining together bishop, knight and queen, has finally *mated* her partner for life. We believe that chess has been too long overlooked by our enterprising maidens, and we look forward confidently to the time when as an ally to such songs as 'Will you love me then as now?' with its suggestive answer of 'Dearest, yes! if I have time,' that many victories will be won, and close friendships formed across the magic square."

Some of our editorial brethren are so enthusiastic over the chess skill of our fair queens of chess, that the discussion has become quite warm, and is being carried on in a way that must be unpleasant to the members of the fair sex referred to.

Sir Walter Raleigh is reported to have said: "I wish to live no longer than I can play at chess."

As early as the commencement of the ninth century, the game of chess was in such high repute in the East, that Al Amin, Caliph of Bagdad, is said to have commanded the different provinces of his empire to send to his court all the finest chess players, to whom he allowed liberal pensions, and passed the most of his time among them. On one occasion when he was playing with his freedman, Kuthar, news was brought to him that the armies of his rival, Al Mamun, were carrying on the siege of the city with so much vigor that it was on the point of being carried by assault; and when repeatedly warned of his danger, impatiently cried out, "Let me alone; for I see checkmate against Kuthar!"

e clue
mated
could
curate
tly as-
asking
king,

Harry
nament
by W.
ey No.
e third
for the
f mate,

roblem-
present
which,
success,
nd will
yers to
gurated
kill. It
Journal
off the
s. We
match
trophy.
two of
greeably
en.

s:
re gene-
ally add
of more
hequered
ght and
believe
erprising
ne when
as now?'
ve time,'
s formed

over the
iscussion
n a way
r sex re-

wish to

tury, the
, that Al
nded the
rt all the
pensions,
one occa-
har, news
Mamun,
uch vigor
sault; and
cried out,
r!"